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TOWARDS LOWER FARES AND LICENSING

SOMETHING of significance seems to have been happening in most of the various aspects of British aeronautics during the past week. There has been the outcry against the Minister's decision to close Croydon to the operation of club-owned aircraft, and shortly thereafter to close it to all aircraft. At the other extreme which flanks the new space science of astronautics there has been the conference organized by the Royal Society. These extremes are even further emphasized by the fact that an internationally known aircraft engineer selected a discussion of the possibilities of man-powered flight as fitting subject for a main lecture to the Yeovil branch of the Royal Aeronautical Society. Finally, there was "the air occasion of the year"—the annual dinner of the British International Air Transport Association.

Both the chairman of the Association and the Minister were concerned to emphasize the possibilities of expansion in which Corporation and Independents alike would be able to share, yet the dinner was held against a background in which the I.A.T.A. Traffic Conference at Cannes had failed to come to an agreement and, as the result of much manœuvring and the use of the veto, an open position had been reached in the question of charter fares. No official statement can be expected until the Conference has resumed its deliberations and reached a unanimous decision. Meantime, the position has already been discussed in print and there does seem to be general agreement regarding what happened. This is not the first time the veto has been used, for in a gathering where votes must be unanimous, the veto must provide a potent bargaining counter.

The situation has to be viewed against recent developments. Over the past few years the independent operators in Great Britain, clinging firmly to the principle that lower fares means wider business prospects, have been demonstrating what can be done with the inclusive tour business. Since 1957 B.E.A. has devoted considerable resources to the mysteries of "motivation" or of the forces, psychological as well as economic, behind the holiday-making habits of the inhabitants of these islands. The outcome of this survey has been a decision by the Corporation to go all out to promote as much business as possible among that large proportion of the population which works in factories and spends its holidays at home. This market is, of course, extremely seasonal; it does not seem to matter where people go, if one excepts the comparative few who holiday in the winter, but holidays are mainly taken each year between mid-April and mid-September.

Carrying this potentially tremendous peak traffic is clearly going to call for some extremely ingenious techniques if loads are to be kept up in off-peak periods. We hold an extremely unpopular view which is that nationally owned airlines should devote their energies to building up the highest possible average load factor throughout the year and do this by eschewing peak loads. However, economic pressures are such that these views are not likely to be adopted or even considered overlong. To our way of thinking the advantage of this view is that the peak traffic can be dealt with by the independent operators who are, by the very nature of events, better situated to deal with the question of redundant aircraft in the non-holiday months. And if one discusses this aspect of their affairs with the Corporation one is liable to be told that in any event the Corporation gets no financial aid for running non-economic services.

Incidentally, this is why the helicopter gets so poor a showing. And indeed it is worth noting that no mention of the helicopter nor of the VTOL services it offers was heard at the B.I.A.T.A. dinner. This does not mean, as we are sure most people know, that numerous operators of helicopters are not doing well with rotary-wing craft, but these operations are very often in the far places of the world whence news travels slowly.

It seems fairly certain that we are going to have continued pressure from B.E.A. and Independents alike for lower fares. And with the lower fares will come the simplification of passenger accommodation and service. In this field we may well see, not too far in the future, strap-hanging airline services to European capitals; the missing link here is some ingenious safety-harness to secure the strap-hanger at take-off.

One certain outcome of the present situation seems a new licensing authority. The Minister speculating, as he said, seemed to be envisaging a new licensing body. Basically, this could be achieved by extending the powers of the Air Traffic Advisory Council. Besides being given powers to license routes, it would also be given powers to license operators. Considerable emphasis was given in both Capt. Morton's speech and in that of the Minister, to means for ensuring that air transport operations were not available to frivolous and inadequately organized concerns. It seems fairly certain that the formation of this new body could not be undertaken until after a General Election.

C

MATTERS OF MOMENT

For Home Consumption

THERE will be widespread approval for the action of those Government supporters, already over a score at the time of going to press, who have signed the motion sponsored by Mr. F. W. Farey-Jones (Cons., Watford), by Mr. Currie (Cons., Down N.) and Lt.-Col. McKibbin (Cons., Belfast E.). The motion urges the Government to provide the capital needed to prevent the sale abroad, outside the Commonwealth, of "certain outstanding new inventions in the field of aeronautics." As a result of the visit of Dr. Barnes Wallis to the United States and the news that there is to be Anglo-American joint research into "variable-geometry" aircraft, it is generally assumed that the "Swallow" is one of the inventions intended to be covered by the motion.

We trust that Government action will cover a much wider field than that, not excluding the Fairey Rotodyne. As a result of the present policy dither on manned military aircraft, some of our most distinguished designers are hamstrung in their efforts to develop new aeroplanes. By now we ought to be hearing of plans to press on with VTOL developments. There have been rumours of such a design from Hawkers but no official statement has been made. It would be a fine thing if the first high-speed VTOL aircraft in this country were to be built for a foreign buyer.

Now for Man-powered Flight

OVER the past few years there has been a considerable revival of interest in the possibilities of man-powered flight. In France a prize has been offered for a machine to fly by human power alone; the Aéro Club de France is considering the rules for the competition. In Russia a "Muscle-powered Flight Committee" has been formed. In this country a Man-powered Aircraft Committee (Mapac) has been in being since the beginning of 1957. As a result of its work a Man Power Flight Group has now been formed within the Royal Aeronautical Society.

In this issue of THE AEROPLANE we give space to the main points raised by Mr. B. S. Shenstone in a lecture on the subject of man-powered flight to the Yeovil branch of the Royal Aeronautical Society. Mr. Shenstone's conclusions make stimulating reading. So little more remains to be done, in his view, before muscle-powered flight becomes practicable. What an exciting proposition for every technological institution in the country!

It should be possible, with enthusiasm, to put in hand experimental programmes for students all over the country to undertake. If anyone needs to be reminded, before the War students of the de Havilland Technical School used to produce entries for the King's Cup Race—a man-powered aircraft ought to be much less expensive.

B.I.A.T.A. PRESIDENT.—Mr. Eric Rylands who has been elected the first president of B.I.A.T.A.; hitherto, this association has had a chairman.

de Havilland Executive Changes

A NUMBER of new elections to the boards of the de Havilland Aircraft and Engine companies and other senior executive appointments have been made recently. In the de Havilland Aircraft Co., Ltd., Mr. C. T. Wilkins, O.B.E., F.R.Ae.S., the chief designer at Hatfield since 1954, and Mr. J. Cunningham, D.S.O., O.B.E., D.F.C., D.L., the company's chief test pilot since 1946, have both been appointed to the board of directors as from December 1, 1958; in his new appointment Mr. Wilkins becomes also chief designer of the whole company.

Mr. R. E. Bishop, C.B.E., F.R.Ae.S., who has been the company's design director since 1955, now becomes deputy managing director. Mr. R. M. Clarkson, O.B.E., B.Sc., A.C.G.I., F.R.Ae.S., who has been on the board since 1952, becomes research director. And, as we have recorded on page 762, Mr. H. Povey retires from the board at the end of this month.

New senior appointments at Hatfield include that of Mr. R. G. McCoy, B.Sc., A.F.R.Ae.S., A.M.S.I.A.E., to the post of general manager of the de Havilland Aircraft Co., Ltd.

NEARLY READY.—Expected to fly within two or three weeks, the first Vickers Vanguard was undergoing resonance testing at Weybridge when this picture was taken. This aircraft is Vickers' own; the first of the B.E.A. fleet for 20 are following close behind and will help in the C. of A. programme, while the first T.C.A. Vanguard, No. 7 in the production sequence, is soon to go into the fuselage assembly jigs.

NEW DIRECTORS.—New de Havilland directors are, left to right, J. Cunningham, C. T. Wilkins, of the aircraft company; and W. F. Shaylor and A. D. Baxter of the engine company.

Mr. D. R. Newman, A.F.R.Ae.S., has been appointed chief aerodynamicist while Mr. M. Herrod-Hempsall remains responsible for administration of the aerodynamics and allied departments.

In the de Havilland Engine Co., Ltd., there have also been two new appointments to the board. These new directors are Mr. W. F. Shaylor, the company's commercial manager, and Mr. A. D. Baxter, M.Eng., M.I.Mech.E., F.R.Ae.S., F.Inst.Pet., chief executive of the rocket division and nuclear power group. In his new appointment Mr. Shaylor becomes sales director.

Croydon—Continued

AT a Press conference at Londonderry House on November 13, COL. C. F. H. GOUGH, Royal Aero Club chairman, expressed the feeling of the private-flying movement generally regarding the closing of Croydon Airport when he described the Government's proposed step as "a national disaster."

The club, he said, viewed this move "with alarm and despondency." Croydon has all the attributes essential for the development of private flying; it is within easy reach of London; it has excellent public transport facilities, adequate airport buildings and hangars, Customs, grass landing area and adjacent hotel. It should be developed as a British National Aviation Centre at which all aeronautical interests, other than commercial flying, could be represented and encouraged.

He went on to say that no other aerodrome so far proposed as an alternative has these facilities, and no acceptable security of tenure has been offered. The club welcomed the recently formed Joint Standing Committee and Col. Gough put forward the plea that their friends in the Ministry would "have another think on this vitally important subject."

Despite this praiseworthy, if somewhat belated, effort on the part of the R.Ae.C., MR. AIREY NEAVE, Joint Parliamentary Secretary to the M.T.C.A., stated during the debate on Croydon in the House on November 14, that "all flying activities by clubs must cease on December 31 next." The clubs will have to get out of Croydon "more speedily than the transfer of charter and executive flyers and other business firms using Croydon," who may remain at Croydon for a very limited period after December 31.

MR. FRANK BESWICK (Lab., Uxbridge) opened the debate, and the main point he made was that if Croydon is closed London will be one of the few capital cities around which there is not one airport available for light aircraft; Paris has seven, New York has 11. In his reference to "a sad story of muddle and contradictions" he considered all the points which had been put forward by the Ministry.

He felt that the present users of the aerodrome had not been given a fair deal; the alternative proposals of Biggin Hill and Gatwick were not acceptable for various reasons. At the former aerodrome the cost of providing accommodation is prohibitive, and similar expense would be involved if the clubs moved to Gatwick.

It may be that the statement by GP. CAPT. C. A. B. WILCOCK (Lab., Derby, N.) epitomized the true situation when he said "I believe that the question of private flying is still not thoroughly understood by the Government, and it may be that it has not been understood by any Government which we have had so far." He said that no operator could work efficiently from Gatwick at present, and that Croydon should be kept for the flying clubs and private fliers, and for the business men who fly in from the Continent in the smaller executive aircraft.

Mr. Neave acknowledged that the Government had a considerable duty to private flying, but that not even an increase of the use of Croydon by four or five times would bring in enough revenue to justify its remaining open; the cost of running the airport, with all things considered, amounted to £93,500 for the year ended March, 1958.

SWEET KNELL OF OLD CROYDON

OR THE VOICE OF OFFICIALDOOM

History Made Easy

FIFTY years of aviation were covered by Mr. G. E. Petty, M.I.Mech.E., F.R.Ae.S.—who, until 1951, was chief designer of Blackburn and General Aircraft—in his Sir George Cayley Memorial Lecture to the Brough Branch of the Royal Aeronautical Society in Hull on November 12. He chose as his subject the history of the Blackburn company on which he was well fitted to speak, having been associated with it for 35 years. He was introduced by Mr. N. E. Rowe, the company's technical director, as a well-known and well-loved figure in the industry and an engineer by instinct as well as by training.

By confining himself to an account of Blackburn aircraft he treated his large audience to a fascinating survey of the development of Naval aircraft over five decades. In the subsequent discussion, the questions and answers stirred up more reminiscences—and comparisons with the present.

It was on a rather nice plane of informality that the evening was spent. A vote of thanks was proposed by Mr. Eric Turner, the company's chairman, who had a dig at the mathematics of chief designers. This vote of thanks was seconded by Mr. G. B. Fenton, project manager, who so rightly commented that

Contents of this Issue

MATTERS OF MOMENT ..... 738 and 762
NEWS ITEMS ..... 741 and 771
AIR TRANSPORT 742
ELECTRA IN ENGLAND 742
ENTER—THE ARGOSY 748
NEW WORLD PHOTO-NEWS 759
FLYING THE LINNET, by John Fricker 760
ROUND SOUTH AMERICA BY JET PROVOST, by R. N. Rumbelow 764
THE FIGHTING SERVICES 766
NATO IN THE SPACE AGE—2 767
NEWS OF INDUSTRY 769
PRIVATE FLYING AND GLIDING 770
CORRESPONDENCE 773
WREN'S WROUNDABOUT 773
NOTES AND EVENTS 774

history is much more interesting when it is told by someone who has been actively engaged in making it.

A visit to see the Blackburn team is always enjoyable for they have a tremendous enthusiasm for the task in hand. Having succeeded in flying the first NA.39 to schedule in April, the second just before the S.B.A.C. display and now, we understand, the third, the team's spirits are high. No one seems to be more enthusiastic about the aircraft than the company's test pilot Derek Whitehead who told us that during all the flying to date—including at least one trip South in very bad weather—the NA.39's behaviour has been exemplary. Quite obviously the controls and the flap and leading-edge "blowing" system have combined to give an aeroplane which promises to be easy to fly in difficult circumstances.

Apart from production of the NA.39, now apparently in full swing, there is some healthy activity at Brough in the engine division where Palouste auxiliary power units and air-starting units are being built in quantity; about 10 of these engines are at present being built every month. The two prototype A.129 840-s.h.p. free-turbine engines, based on the Artouste with a transonic compressor and a Turmo gearbox, are undergoing preliminary development and performance running on the test-beds. For the present one of these engines is being run as a gas producer and the other as a free-turbine unit.

An Anglo-Australian Pilot

HARRY F. ("JIM") BROADBENT, who was piloting the Martin Mariner, CS-THB, of Aero Topographica (Artoc) which was lost on a flight from Lisbon to Madeira on November 9, was aged 48. Although he lived in Australia for 36 years he was, in fact, born in England.

Before the War he set up several solo records between England and Australia; the last one, in a Percival Vega Gull in 1938, took 5 days 5 hr. 21 min. and beat by nearly 13 hr. the existing record held by Miss Jean Batten. This flight has not been officially beaten, nor has his round-Australia flight of the same year.

In 1938 Jim Broadbent decided on a commercial pilot's career, having acknowledged the purely sporting value of such record flights, and with his enthusiasm for flying-boats came to Britain, took a flying-boat course and gained his first-class navigator's certificate. He joined Qantas as a first officer in 1939.

He returned to Britain in 1956 to fly Solents for Aquila Airways, and remained with that company until it closed down. Thereafter he flew for the Portuguese Artoc airline. He was recognized as one of the best pilots produced in Australia and by his untimely death the world of commercial aviation loses a valuable and well-liked member.

The Royal Society Discusses Space Research

MORE than two hundred persons attended the two-day discussion on Space Research arranged last week by the Royal Society in London. The Universities, the Scientific Civil Service, the Aircraft Industry and numerous other bodies from many parts of the World were represented.

Opened by PROFESSOR H. S. W. MASSEY, F.R.S., the discussion concerned itself almost exclusively with the scientific results gained from satellites and other high-altitude research leading on to the prospects for further exploration throughout the solar system. Such discussions clarify the design problems for space vehicles, some of whose characteristics, which may influence the extent of the experiments, were outlined by staff of the Royal Aircraft Establishment. Astronomers joined with physicists in describing the advantages in making measurements beyond the atmospheric "blanket."

The conference may be considered as an important step towards the general acceptance in scientific circles of the true value of space flight for research. It showed how much scientific data has already been obtained from the satellites in just over a year. The extent of international collaboration in these matters was underlined and the limitless prospects for future work were touched upon.

PROFESSOR D. R. BATES, F.R.S. (Queen's University, Belfast), described the scientific problems concerning the Earth's atmosphere above heights of 100 km. in the light of recent rocket sonde measurements. At these heights there is a complicated interplay between atoms of nitrogen, oxygen and hydrogen and the radiations arriving from outer space.

In 1953 the temperature at 100 km. was taken to be 220° K. with typical gradients of 5° K./km. Recent evidence indicated gradients of 20-35° K./km. and ionospheric temperatures approaching 1500° K. Such high gradients could only be explained by the supply of large sources of energy to the upper atmosphere.

PROFESSOR S. CHAPMAN, F.R.S. (who has laboratories at Alaska and Colorado) spoke on interplanetary space and solar-terrestrial relations. He felt that the solar corona, which extends as far as the Earth, may be a cause of the energy input. Its temperature is of the order of a million degrees (K.) which need not, however, deter the would-be space traveller as the rate of transfer of heat to solid bodies is low because of the virtual vacuum conditions. As SIR GEORGE THOMSON, F.R.S., asked: "What is meant by 'temperature' out in space?"

PROFESSOR T. GOLD, one-time Cambridge astronomer now at Harvard, gave a brilliant, imaginative account of some of the physical characteristics of the moon, the nearer planets, and the intervening space and what kind of experiments could be made with rocket probes. In space itself measurements would be made of density, temperature, magnetic fields and electro-magnetic particles having a very wide range of energies from the 10 keV of the auroræ to the hundreds of BeV of the cosmic rays. On the moon surface features would be televised, traces of an atmosphere would be sought and rock structures investigated by means of small surface explosions. What we all want to know is whether there was life of any kind on Mars and whether, in the first instance, evidence of this could be detected in its atmosphere. Professor Gold said that solar probes could provide scientific data of great value.

PROFESSOR HOYLE, F.R.S., foresaw a great extension to astronomy which would result from the placing of, say, a 20-in. telescope on a stabilized Earth satellite. Without the blanketing and blurring effect of the Earth's atmosphere visual observations could be expected to greater distances and additional wavelengths could be used such as ultra-violet, infra-red, X-ray and γ-rays. The continuance of many important aspects of cosmological theory awaits such a development.

DR. R. D. DAVIES, of the Jodrell Bank Experimental Station (deputizing for Professor Lovell), showed how radio astronomy could be enhanced by operating outside the atmosphere. Shorter wavelengths of interest could be used which are absorbed in the atmosphere and the ionosphere forms a natural screen for man-made radio interference on Earth.

DR. R. L. F. BOYD (University College, London) and PROFESSOR J. SAYERS (Birmingham University) described the measurements made as part of the British contribution to the I.G.Y. and also plans being made for measurements not so far attempted. The Universities are working to very tight budgets for this work and the instruments exhibited showed considerable ingenuity in design and construction. The biggest laugh of the conference was caused by Professor Sayers when describing his mass spectrometer. "The central body looks rather like a saucepan—and indeed *is* a saucepan!"

The limitations imposed on space experiments by the performance of rocket vehicles, their control, communications and tracking were presented by DR. A. W. LINES and MR. W. T. BLACKBAND (R.A.E.). A satellite could be stabilized in space by means of electrically rotated and controlled masses or by multiple reaction jets. The reference system to which the satellite is aligned could be the fixed stars and an automatic star seeker to do this might weigh 100-200 lb.

MR. D. KING-HELE (R.A.E.) gave some fascinating results of his precise analysis of satellite orbits—an outcome of the work of the prediction service run by the R.A.E. The three topics were determination of air drag and its erratic variations during either the life of the satellite or its location over the Earth, the changes in the inclination of the orbits and the re-evaluation of the equation for the Earth's gravitational potential.

"BISONIUS."

News of Aircraft, Engines and Missiles

SWALLOW PROGRESS. — Further steps towards variable-geometry aircraft are being taken with the visit of a joint M.o.S. and Vickers-Armstrongs team to America. They are to explore the possibility of Anglo-American research on such aircraft with particular reference to the Swallow project of Dr. Barnes Wallis, from which Government support was withdrawn last year. The visiting team includes Dr. Barnes Wallis, from Vickers-Armstrongs, Mr. P. A. Hufton of R.A.E. Bedford and Mr. J. Christie, an assistant secretary of the M.o.S.

IROQUOIS TESTS. — More than 100 hr. of testing of the Orenda Engines Iroquois have been completed at the Lewis Flight Propulsion Laboratory in Cleveland. Inlet temperatures reached were higher than ever before attained without adversely affecting an engine mechanically.

NEW JINDIVIK.—The latest British order for Jindiviks is reported to be for the Mk.2A version, which has improved climb and will operate at 60,000 ft. It has an enlarged fuselage and wing and a larger and relocated air intake.

RECCE DRONES. — The guided-missile division of Republic Aviation is to produce 20 advanced combat surveillance drones and two ground-control guidance stations for the U.S. Army's Signal Corps. The all-weather and recoverable jet-propelled drones use photography, radar and infra-red observation techniques. A smaller propeller-driven drone, the SD-3, and Atlas and Thor nose cones are also made by the division.

AIR BIKE.—The Hiller XROE-1 Rotocycle is to be built under licence by Saunders-Roe, Ltd. Its 45-h.p. Nelson engine gives it a cruising speed of 55 m.p.h.

HAWKER VTOL? — The Hawker P.1127 is said to be a VTOL tactical aeroplane projected for NATO requirements as a third-generation type to follow the Fiat G.91 and Breguet Taon.

FOKKER PRODUCTION.—During 1957 the Fokker factories in Holland delivered 45 Hunters to the R.N.A.F. and 21 to the Belgian Air Force, together with 58 sets of main components. In addition 51 Hunters were overhauled and modified at Schiphol.

AUTOGIRO REVIVAL.—It is reported that the Kellet Aircraft Corpn. of Willow Grove, Pa., is to begin producing Autogiros again. The company developed and supplied the first military Autogiros for the U.S.A.A.C. in the early 1930s.

VTOL TESTS.—Flight development programmes have begun with the Doak Model 16 and Ryan Vertiplane VTOL research aeroplanes.

LECTURE DATE

We remind our readers that on Monday next, November 24, the first of the Royal Society of Arts' Cantor Lectures will be given by Mr. C. H. Gibbs-Smith, who will discuss "The Birth of the Aeroplane." The lecture is at 18.00 hrs. at John Adam Street, Adelphi, London, W.C.2.

JETSTAR PRODUCTION. — The Lockheed Aircraft Corpn. has announced that the Jetstar utility transport is to be put into production immediately at the Georgia Division to meet "off-the-shelf" orders. This aircraft is offered in two versions, one with two Bristol Orpheus turbojets and the other with four Pratt & Whitney JT-12s or General Electric J85s. The Orpheus version has flown more than 330,000 miles on test, at speeds up to 685 m.p.h., heights of 52,000 ft. and ranges of 3,105 miles.

NIKE HERCULES.—A Nike Hercules surface-to-air missile recently made the first interception of a target flying above 100,000 ft. The missile is reported to have a range of about 75 miles.

FRENCHMAN ABROAD.—A second Morane-Saulnier MS.760 Paris (two Turboméca Marboré turbojets) has been assembled and test flown by the Beech Aircraft Corpn. It will be used as a company demonstrator. An armed version of this type for the Argentine Air Force, assembled at Cordoba, has also made its first flight.

IMPROVED SKYHAWK.—A $79 million U.S. Navy contract has been awarded to Douglas Aircraft for production of a third version of the Skyhawk light attack bomber, the A4D-2N. It has improved weather and navigation capabilities, the latest pressure- and in-flight refuelling equipment, and is nearly a foot longer than earlier versions. The prototype is now being evaluated at Edwards A.F.B.; first deliveries are expected next year.

BELLIGERENT BOUNDER.—It is reported that the Russian supersonic bomber code-named Bounder has turbojets buried in the roots of its delta wing and auxiliary engines in pods on both sides of the fuselage. Span and length are estimated to be 75 ft. and 200 ft. It is thought to have a Mach-2 performance.

ROCKET RECESSION.—The M.o.S. development contract for Napier's Scorpion rocket motor will not be renewed when it comes to an end next year. This suggests that the R.A.F. has no requirement now for a rocket-boosted version of the Lightning, which it was planned should have a Double Scorpion.

FIRST PRODUCTION.—The first post-War German-built jet aircraft—a French-designed Air-Fouga Magister trainer produced under licence by Flugzeug Union Sud, an amalgamation of Heinkel and Messerschmitt—was handed over to the West German Air Force on November 10. Approximately 200 Magisters are to be built in Germany.

SPONSORING RESEARCH. — The United Research Corporation has been formed by the United Aircraft Corporation of America "to sponsor and support basic research in fields pertinent to its interests." Initially the new corporation will support research into advanced propellents for missiles and space craft. President of the new Corporation is Lt.-Gen. Donald L. Putt.

BOEING MOD.—The use of vortex generators on the fin of the 707 (see THE AEROPLANE of September 12) appears to have removed the need for hydraulic boost for the rudder. The flow has been improved in this way so that normal operation of the surface is practicable in all conditions. The spoilers on the wing can be used to trim the 707 in the event of any emergency involving a "freeze-up" of the normal trim.

ITALIAN TRAINER.—The all-round performance of the second prototype Macchi MB.326 has been improved by the installation of an Armstrong Siddeley Viper ASV.11 turbojet instead of a Viper ASV.8.

MORE NEWS ITEMS ARE ON PP. 771-2.

Air Transport

Electra in England

LOCKHEED demonstrated their Electra turboprop transport at Gatwick Airport last Monday with masterly effectiveness. Making its 28th call since it left Burbank on October 5, this Electra (N7144C, the fourth built) flew in from Paris, made three demonstration flights on schedule and flew off again for Paris and Wiesbaden, all in a matter of five hours or so. Careful planning of the flights permitted a maximum of characteristics to be demonstrated, and an informative broadcast by the "flight-deck commentator" kept the passengers fully briefed.

We embarked—by way of the powered airsteps—with the knowledge that 62 demonstration flights of this kind had already been made and the team of Lockheed, Allison, Aeroproducts and AiResearch technicians and salesmen on board had greeted over 2,300 passengers to date. The Electra had totalled some 120 hours on its tour so far, taking in the I.A.T.A. general assembly at New Delhi as the farthest point east. The only servicing problem of note was the replacement of a seal in one engine.

For this tour the Electra was carrying a modified AiResearch A.P.U. as a source of compressed air for starting No. 4 engine. This unit was contained in the forward hold under the cabin floor and moved out for use on rails through the starboard baggage loading door. Starting sequence is No. 4 engine first, and thereafter any order the pilot chooses, using power from the variable-speed generator on No. 4.

We chose a seat about halfway down on the starboard side, where we calculated—and later confirmed—noise was at its worst. Actually the noise level is comfortable even here, and in the quieter parts of the cabin is less, we would say, than in any other turboprop transport flying. Externally, the Electra seemed noisier on the apron than a Viscount, but is free of the Dart's distinctive, high-pitched whine.

For taxi-ing, the engines are brought up to their ground idling speed of 10,000 r.p.m., when the consumption is about 1.5 gal. per min. each engine. In this condition we taxied out to the run-up area of Runway 09, where we paused momentarily for clearance and then lined up for take off. Lockheed's chief engineering pilot, Herman "Fish" Salmon, was in the left-hand seat, with Captain Websper, Transair's chief pilot, flying as first officer. "We always like to have a captain from a prospective customer in the right-hand seat," said Dick Bean, representing Lockheed's public relations.

From the flight deck, "Chuck" Mercer, Lockheed's chief airline operations engineer, told us we were taking off at 95,000 lb.—a typical figure for a 500-mile stage-length with full payload. As the flaps moved out to take-off position, we accelerated down the runway, and cleared ground after an 11-second roll. A brief loiter at 2,000 ft. under A.T.C., was followed by a quick climb through the murk of an English November day into sunnier regions at 15,000 ft. The Allison 501D-13—cleared for 1,000 hours between overhaul—is a constant speed engine, the appropriate setting being 13,820 r.p.m. from take-off to touch-down. At normal climb power, we were pulling 3,100 h.p. from each engine, the power being indicated directly in the cockpit together with turbine inlet temperatures and r.p.m.

Now we were able to appreciate the décor of the Electra. The interior was a Lockheed design, with four-abreast seating for 66 passengers (plus a six-seat rear lounge). Seat upholstery alternated between mid-blue and buff, the cabin lining being basically fawn and quite restrained. Passenger service panels in the capacious luggage racks provide for four or five abreast seating and have oxygen points to which the individual Zep Aero masks can be attached if necessary. Galley and toilet facilities both are geared to short-range and medium-density operations.

Much of the flight demonstration was concerned with the engine responsiveness and flexibility. At 15,000 ft., first No. 4, and then No. 3 engine was cut and feathered. Then, with two "out" on one side, No. 2 was throttled back to zero power and we continued on No. 1 alone, at maximum continuous power. In this configuration the Electra will hold altitude at about 6,000 ft. at average weight.

Up on the flight deck, Salmon and Mercer were happily answering questions from a stream of visitors. The flight deck—laid out primarily for U.S. domestic operation with two pilots and a jump-seat between for the engineer when carried—is roomy enough to allow this. Over the second pilot's position a notice read "Happy Pilots are Better Pilots." We think Electra pilots will be happy pilots.

On the approach back to Gatwick, we were treated to a demonstration of the Electra's responsiveness to power change in the landing configuration with wheels and flaps down. Operation of the power levers forwards and backwards has an immediate and startling effect, as one is alternately pressed into the seat and forced against the seat belt.

Normal operation of the Electra on multi-sector routes involves stopping Nos. 1 and 2 engines only at intermediate stops, and this was demonstrated as we disembarked, while Nos. 3 and 4 grumbled on at ground idling. Also typical of operations was the lack of refuelling between flights.

Electras will go into service with Eastern Air Lines on December 1 and with American Airlines in January. By then, about two dozen will be "out of the door" and 10 delivered;

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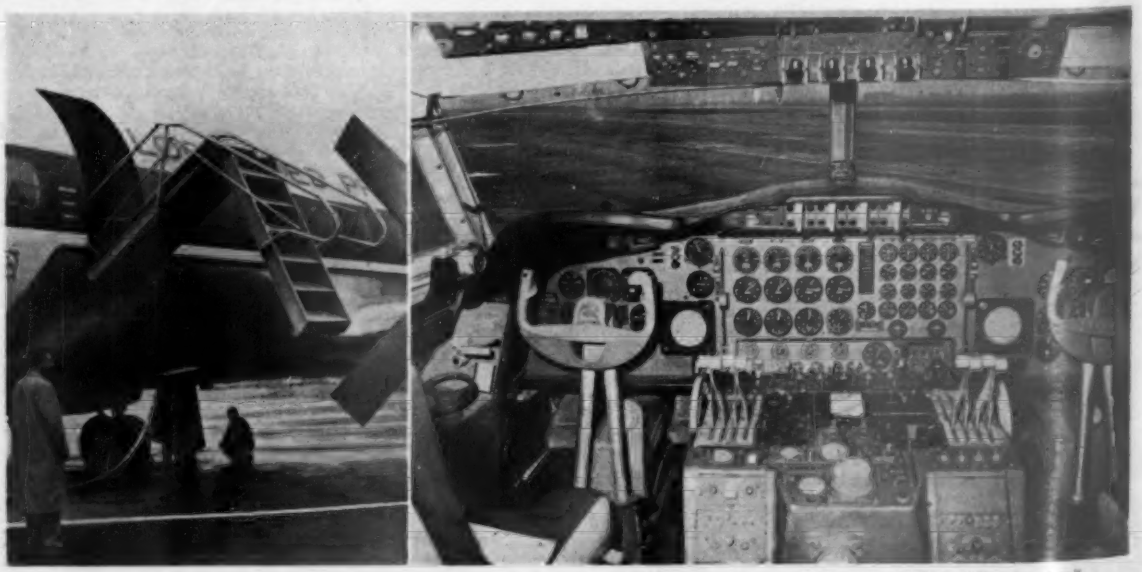
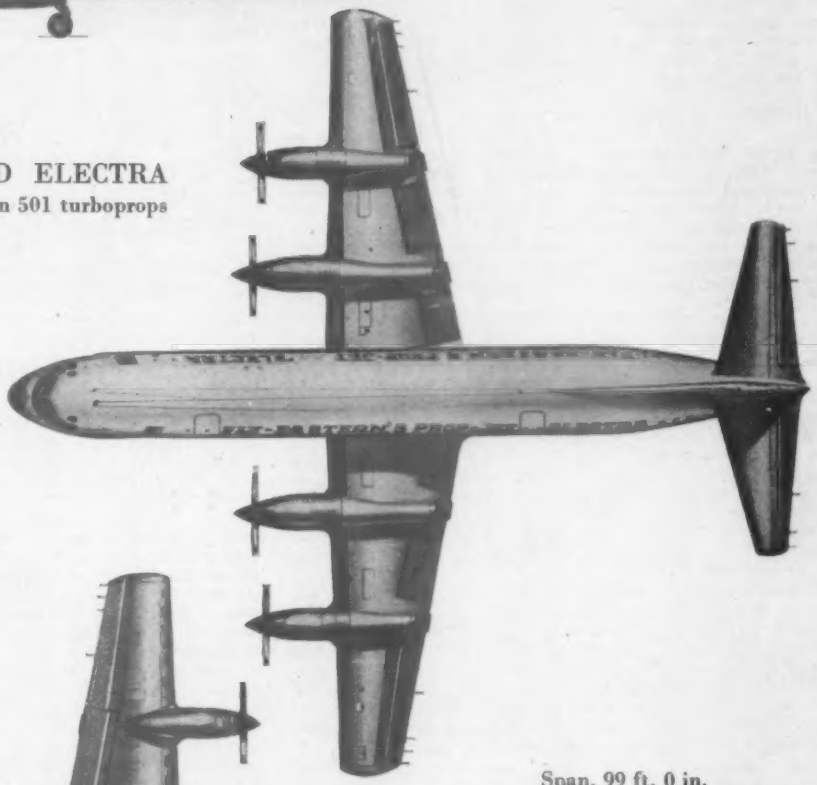


Photographs copyright "The Aeroplane"

The Electra is tailor-made for multi-sector operations and quick turn-rounds. The airsteps, left, contribute to 15-minute turn-rounds. Right, the cockpit; and, opposite, the Electra in Eastern Air Lines markings.

THE LOCKHEED ELECTRA

Four 3,750-e.h.p. Allison 501 turboprops



Span, 99 ft. 0 in.
Length, 104 ft. 6½ in.
Gross weight, 116,000 lb.

"The Aeroplane" drawing by Roy Cross

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(*Continued from page* 742)

the Allison engine will have accumulated 350,000 hours flight time, including military experience. From the 20th aircraft, Electras will be cleared for operation at 116,000 lb. gross weight. This compares with an initially announced weight of 98,500 lb.; subsequently this grew to 110,000 lb. after Lockheed had designed in more tankage to widen the appeal of the Electra. The design payload was then 18,000 lb.

Ahead of schedule by 56 days, the first Electra flew from Burbank on December 6, 1957, by which time the gross weight had increased to 113,000 lb., and the weight-limited payload to 26,500 lb. Together with Electras No. 2 and 4 (Lockheed-financed) and No. 5 (first for Eastern Air Lines) this aircraft began official certification trials in June of this year after extensive preliminary flying by Lockheed. No. 3, incidentally, was used for static testing and was then converted to an aerodynamic prototype of the U.S. Navy's P3V-1 patrol aircraft.

Certification by the C.A.A. was completed on August 22 and Lockheed were able to announce that they had equalled or bettered all their performance guarantees. Specifically, C.A.A. take-off distance and landing distance were better than forecast, and two- and three-engine en route altitude capabilities were improved. Flights were made at weights up to 116,000 lb., and this weight was approved for future production models.

Orders for the Electra now total 160, not counting the first Lockheed machine and one used for engine development by General Motors, but including 10 which Northwest Airlines has stated it will buy. The Electra for Northwest, at 116,000 lb., will also have additional fuel (about 750 Imp. gallons) in fillet tanks to ensure adequate reserves for year-round non-stop operation between New York and San Francisco.

Other orders for the Electra are as follows: American Airlines, 35; Eastern Air Lines, 40; Braniff, 9; National, 23; K.L.M., 12; Western, 9; Garuda, 3; Cathay Pacific, 2; Pacific Southwest, 3; Aeronaves de Mexico, 3; Ansett-A.N.A., 2; Qantas, 4; TEAL, 3; T.A.A., 2. Additional background information on Electra development was published in THE AEROPLANE for July 4, 1958; the airframe and systems were described in our issue for December 27, 1957, and the structure was commented upon in the issue for August 22, 1958.—F.G.S.

ELECTRA DATA

Dimensions.—Span, 99 ft. 0 in.; length 104 ft. 6½ in.; height, 32 ft. 11½ in.; gross wing area, 1,300 sq. ft.; internal cabin width, 128 in.

Weights.—Basic operational, 58,900 lb.; max. payload, 26,735 lb.; space-limited payload (domestic custom interior), 18,000 lb.; max. take-off weight, 116,000 lb.; max. landing weight, 95,650 lb.; max. zero fuel weight, 86,000 lb.

Performance.—Max. cruise speed at 22,000 ft. and 85,000 lb., 352 knots; approach speed at max. landing weight, 121 knots; C.A.A. balanced field length (SR. 422) at sea level, in I.S.A., at 106,700 lb., 4,148 ft. (demonstrated); C.A.A. landing field length at sea level, in I.S.A., at 85,500 lb., without reverse thrust, 4,266 ft. (demonstrated); max. still-air range, take-off to landing, no reserves, 3,170 naut. miles with 21,195 lb. payload at 325 knots (mean) and 26,000 ft. (mean); range with max. payload, take-off to landing, no reserves, 2,900 naut. miles.

Electra Power by Allison

ANY commercial aeroplane can be only as successful as its powerplant, so when a new aircraft appears powered by a new type of engine the technical interest is considerable. The case of the Lockheed Electra is all the more interesting because it is powered by four Allison 501 turboprops, the first large civil engine of this type to be produced in the U.S.A. The Allison engine has, of course, a considerable background as a military unit—the T56, which powers the Lockheed C-130A Hercules assault transport.

In view of the considerable amount of turboprop pioneering done in Britain, the American approach to the same type of engine is noteworthy. The most obvious and basic difference is in the nacelle layout. British turboprops are close-coupled to their propellers and have annular air intakes around the spinners. The Allison engines are arranged quite differently in that the power unit is placed some distance behind the propeller, which it drives through an extension shaft and separate gearbox providing a propeller axis above or below the engine.

This arrangement allows more convenient undercarriage stowage for the inboard engine nacelles of a low-wing aeroplane such as the Electra and has the advantage of having an air intake on the top of the propeller only, where it is less likely that runway debris may be drawn in. Efficiency of the intake is high because there is a high degree of ram-pressure recovery and the compressor intake face is relatively remote from the air intake lip, the effects of propeller blades passing close to the compressor being avoided.

Disadvantages of this layout are the extra weight of drive and torquemeter shafting; of tubular supports to the remote gearbox just aft of the propeller, and the sheer length of the resulting power unit—although this may not necessarily be an embarrassment.

Another important point is that the Allison Model 501 is a single-spool "solid"-shaft engine whereas the latest thoughts in this country are for two-spool large turboprops such as the Rolls-Royce Tyne and Bristol Orion. Smaller and earlier British engines are of single-shaft layout, good examples being the Rolls-Royce Dart and Napier Eland. The single-spool two-shaft Bristol Proteus is a variation on this in having a free power-turbine driving the propeller reduction gear.

The single-spool engine is certainly simple, but its pressure ratio is limited unless variable-incidence inlet guide vanes and stator blades are resorted to so as to retain flexibility of compressor handling characteristics at low speeds. This has been done by General Electric with the J79 turbojet, its CJ-805 civil derivative and the T58 small shaft-turbine, giving very low weight at the expense of some mechanical complication.

However, a good specific fuel consumption is essential for a commercial engine and this is where the two-spool engine scores. The Allison Model 501-D13 with a take-off power of 3,750 e.h.p. at an s.f.c. of 0.543 lb./e.h.p./hr. is contrasted by the Rolls-Royce Tyne R.Ty.11 with an s.f.c. of 0.48 lb./e.h.p./hr. at 5,525-e.h.p. take-off power. In maximum continuous cruising conditions at 3,375 e.h.p., the Model 501 s.f.c. increases to 0.555 lb./e.h.p./hr. and to 0.592 lb./e.h.p./hr. at 2,700 e.h.p. In contrast, the Tyne s.f.c. improves to 0.388 lb./e.h.p./hr. when cruising.

On a power/weight ratio basis, the maker's claims for the Allison Model 501-D13 are difficult to substantiate. The statement that the ratio of 2.14 e.h.p./lb. is more than is produced by "any known U.S. or foreign prop-jet engine" hardly tallies with ratios of 2.49 e.h.p./lb. for the Tyne R.Ty.11 and 2.78 : 1 e.h.p./lb. for the D.H. Gnome (General Electric T58).

It is, however, rather unfair to compare the Allison Model 501-D13 with modern engines such as the Tyne and Gnome, which naturally benefit from more up-to-date technology. A more apt comparison can be made with older designs such as the Napier Eland N.El.6 and Bristol Proteus 765.

Taken in this order, these three engines are respectively of

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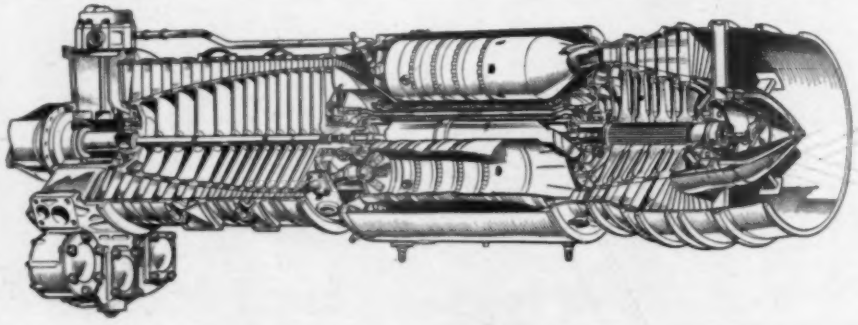


POWER SECTION.—The gas generator of the 3,750 e.h.p. Allison 501 turboprop engine has a 14-stage axial compressor, six cannular flame tubes and a four-stage turbine. Engine weight is 1,750 lb. with reduction gear.

(*Continued from page* 744)

3,750, 3,500 and 4,445 e.h.p. at take-off with associated s.f.c. values of 0.543, 0.60 and 0.60. Comparative power/weight ratios are 2.14 : 1, 2.0 : 1 and 1.53 : 1.

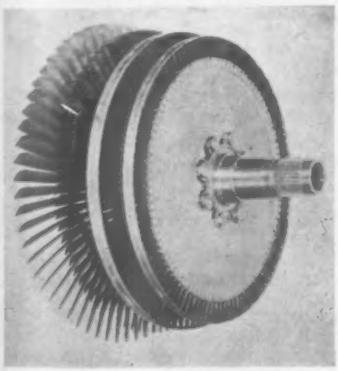
Background to the Design

In years gone by, the Allison Division of General Motors Corpn. has not been particularly successful in the design of aero-engines other than the J33 and J35 turbojets originated by General Electric. It is of interest that the first real Allison-inspired engine was a turboprop, the T38 (also produced in coupled form as the T40).

These engines had protracted development and eventually led to the design of the T56, military forerunner of the Model 501 turboprop used in the Electra. The T56 first flew in the nose of a modified Boeing B-17 flying test-bed. Two Convair YC-131C transports (military versions of the Convair 340) were fitted with 3,250-e.h.p. YT56-3 engines and intensively operated to attain 3,000 hr. of development flying between May and December, 1955, the first YC-131C making its maiden flight on June 29, 1954.

On January 24 this year a 1,000-hr. flight demonstration with a YC-131C was concluded after 84 days, an average of 12 hr. flying each day with the Allison Model 501-D13 turboprop engines fitted. This programme—"Operation Hourglass"—followed a flight schedule based on typical airline operations.

In service with the Lockheed C-130A Hercules the T56 is very similar to the Model 501 engine except that air intakes are under the high wing and the reduction gear is therefore located in the opposite position. Thus the propeller axis of the T56 is above the engine centre-line and not below it. The Aeroproducts propeller of the Hercules is 15-ft. in diameter compared with 13-ft. 6-in. for the four-blade Aeroproducts 606 of the Electra. Aeroproducts is, like Allison, also a part of General Motors Corpn. The Model 501 has a reduction-gear ratio of 13.54 : 1 compared with 12.5 : 1 of the T56. This, with the smaller-diameter propeller, reduces the noise-level considerably.



The first three rotor stages of the four-stage turbine have blades cast in GMR-235 alloy. The blades of the fourth stage are forged in S-816 alloy.

The Model 501-D13 is the commercial version of the T56-A-1 which has been in production since January, 1955. The 501-D15 is a later version of 4,050 e.h.p. which may later be used in the Electra. The 501-D13A is for use with the Hamilton-Standard propeller specified by K.L.M. alone among the Electra customers to date.

Combustion system of the Model 501 consists of six cannular flame tubes in a common annular casing.

Layout of the engine is very straightforward. A 14-stage axial compressor is driven by a four-stage turbine. Pressure ratio is 9.25 : 1 and the air mass flow is 32.5 lb./sec. There are six cannular flame tubes. Take-off e.h.p. is 3,750 (3,460 s.h.p. and 726 lb. thrust) at 13,820 r.p.m., the s.f.c. being 0.543 lb./e.h.p./hr. With this is associated a turbine inlet temperature of 1,227° K. Maximum continuous cruising power at 3,375 e.h.p. results in an s.f.c. of 0.555 lb./e.h.p./hr. These figures are guaranteed ratings in standard sea-level static conditions.

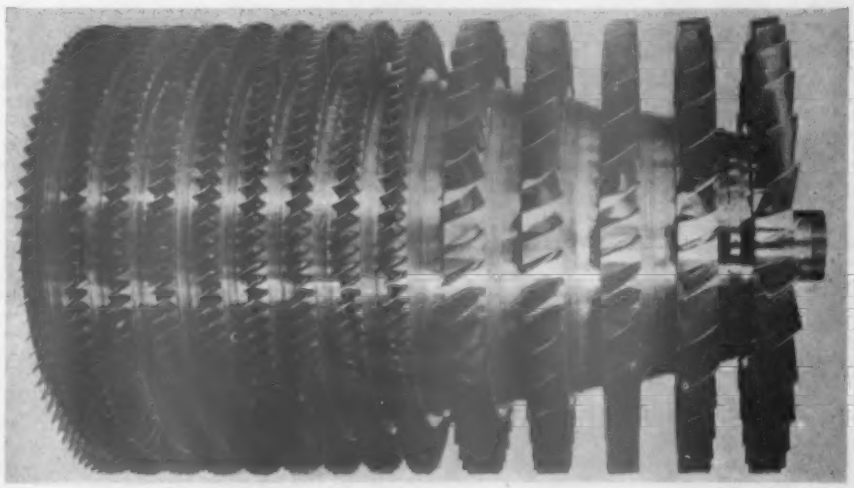
An interesting feature of the design is that the compiete reduction-gear assembly, torquemeter assembly and torque-tube housing, two interconnecting struts and control linkages to propeller and power section are interchangeable between engines, and can be overhauled separately from the power section.

Gas-generator speed of 13,820 r.p.m. is reduced to 1,020 propeller r.p.m. by the 13.54 : 1 reduction gear. Speed reduction is by a primary spur-gear step-down of 3.125 : 1 and a secondary step-down by 4.33 : 1 planetary gears. Accessory mounting pads are located on the rear face of the reduction gear. The gear housing is cast in magnesium: weight of the complete reduction gear assembly is 450 lb.

A negative-torque signal system is built into the reduction gear to avoid windmilling drag in the event of engine failure. Whenever the propeller is absorbing from the airstream about 400 e.h.p. more than the engine is developing, the system automatically increases pitch of the propeller blades until it approaches the feathering angle. If power is regained the propeller blades automatically return to the governing range; if not, the pilot can shut down the engine and feather the blades.

There is also a thrust-sensitive signal device which senses loss of propeller thrust below a pre-set value during take-off. The signal is used to operate a warning light on the flight deck or to start automatic feathering.

In normal operation a safety coupling connects the gas generator section of the engine with the reduction gear through helical splines. When there is negative torque in excess of a pre-set value, a separating force is produced which overpowers the spring force in the coupling and forces the splined members apart. The coupling re-engages when the reduction gear input shaft speed equals that of the gas generator.—D.G.



The 14-stage axial compressor swallows 32.5 lb./sec. of air and has a pressure ratio of 9.25:1 at sea-level. Discs, blades, casings and vanes are all of steel.

Sir Hudson Fysh in London

A SURCHARGE on fares in jet aircraft would be wholly unjustified, in the view of Sir Hudson Fysh, chairman of Qantas Empire Airways, Ltd. In London last week after attending the I.A.T.A. general assembly, Sir Hudson claimed that the Comet, and certainly the Boeing 707 and Douglas DC-8, would be at least as economic to operate as the older types they supersede. A jet surcharge would penalize the public who want to travel in the best aeroplane. He thought manufacturers and airlines alike should devote themselves wholly to the introduction and development of the new equipment now available; too much time was spent in criticising others.

Sir Hudson flew to London via Moscow, making the flight from Delhi to Moscow on the Aeroflot service in the Tu-104. He was impressed by all he had seen of Aeroflot operations in Moscow and thought the Ilyushin Il-18 might prove to be nearly as good as the contemporary Western turboprops. The possibility of Qantas opening a Sydney-London service via Moscow was, however, "remote" and had not been discussed in Russia.

Air Ceylon Affairs

IN the year ending March 31, 1958, Air Ceylon made a profit of Rs. 300,000—the best result in 10 years of operation. Present indications are that an even larger profit will be made in the current year.

Steady progress is being made in the expansion of Air Ceylon's international services. Following a recent visit to Europe by Mr. Maitripala Senanayake, the Minister of Transport, a service to Paris is to be opened, and plans for a second east-bound service through Bangkok to Hong Kong were discussed in London. Mr. Senanayake has been invited to Peking to discuss opening of a service between Colombo and Peking.

In negotiating traffic rights with other countries, Ceylon has at times encountered difficulties because of the smallness of the Government's majority (51%) in the shares of Air Ceylon. Consequently, agreement has been reached with K.L.M. to reduce that airlines' holding in Air Ceylon from 49% to 26%.

Early this month, a Super Constellation L-1049G was acquired by Air Ceylon and is now operating on the routes to Singapore and London. New turboprop aircraft are expected to be ordered soon to replace the two DC-3s.

The National Planning Council in Ceylon recently estimated that Rs. 83 million would need to be spent over the next 10 years on the development of civil aviation. The Council's plan —which is subject to Government approval—envisages the development of Katunayake as Ceylon's International airport at a cost of Rs. 55 million. Ratmalana, Colombo's airport, and Kankasenturai, in the north of the island, would be developed as primary diversion airfields, and four other airports, at Koggala, Ampari, Trincomalee and Sigiriya, would be developed for domestic services.

The decision to develop Katunayake rather than Ratmalana as the international airport has already been announced by the Government, and plans are now being drawn up with the help of the United States Operations Mission in Colombo.

Turbojet Fuel Reserves

TAKING account of additional experience with turbojet transports on proving flights and in certification programmes, the C.A.B. has amended its regulations governing the fuel reserves to be carried by jet aircraft operated by U.S. airlines in accordance with C.A.B. certificates. The new rules covered by the special civil air regulation, SR.427, represent a reduction in the previously required reserves, and they do not apply to turboprop aircraft. The operators are at liberty, of course, to carry larger reserves if they wish.

Fuel must now be carried to fly the specified sector and then

(a) fly for 10% of the time required to fly that sector;
(b) fly to and land at the most distant alternate airport designated in the flight plan; and
(c) hold for 30 minutes at 1,500 ft. over that alternate.

If any destination airport has no available alternate, the aircraft must carry fuel to fly for two hours at normal cruise consumption after arrival at destination.

B.I.A.T.A. and the Future

MR. WATKINSON'S description of the annual B.I.A.T.A. dinner on November 12 as the "air occasion of the year" was rightly received by the organizers of the event as a very pleasant tribute and was warmly agreed by the guests of the Association. The speeches of both the Minister and the retiring chairman of the Association, Capt. T. W. Morton, were remarkable for the breadth of view displayed. The implications of the situation are discussed elsewhere.

First point made by Mr. Watkinson in what he said would be a "personal and speculative speech" was the overriding necessity of a vast expansion in the market for air travel to match the great expansion of carrying power. If the industry is to continue to expand it must find new markets among more modest travellers.

The objective of the Government must obviously be to facilitate the efforts of British airlines to obtain as large a part of the new markets ahead as possible so that all the components of our civil aviation effort, whether nationally owned corporation or independent operator, may retain the traffic they have won in the past and expand it at least in step with the development of traffic in the future.

There is a lot to be said for the plea put forward by the Association and others that independent airlines should run scheduled services in their own right and not merely as associates of the corporations.

Mr. Watkinson made it clear that he favours the low fares policy. Regular scheduled operators should move increasingly towards lower fare structures, whether by way of special holiday travel or by way of lowering the standard fares. He is determined that this should not be at the expense of the British independents losing their rightful share in the development of a market which in so many ways they have made their own.

Mr. Watkinson has in mind some kind of statutory authority. He is considering whether the excellent work done by the Air Transport Advisory Council—combined with the idea lying behind Capt. Morton's suggestion of an operator's licence—might not provide a clue to the right machinery. There are attractions in the idea of a new A.T.A.C., with new powers, revised and wider terms of reference and wider discretion. The Government, however, could not renounce responsibility for ultimate policy decisions.

Welcoming the guests, and in particular, the Minister, Capt. T. W. Morton, the retiring B.I.A.T.A. chairman, briefly surveyed the figures given in the annual report. He spoke of the £11 million being spent by members on new equipment. He made it clear that the Association supports fare differentials for a variety of reasons.

He announced that in future the Association was to have an annually elected president. First to hold the new post was to be Mr. Eric Rylands.

The Annual Report

Although the statistics for the 1957-58 year show that the independent airlines in B.I.A.T.A. made fair progress in most categories of operations, it is difficult to avoid the conclusion that the year was a disappointing one. Reviewing the previous B.I.A.T.A. report (in THE AEROPLANE for December 20, 1957), we pointed out that the prospects of future expansion for the independents depended on the amount of scheduled work which they were permitted to do, and that a decision on the future place of the independents in British air transport affairs must be agreed between the two political parties. Since little or no progress has been made in either of these directions, the independents are really no closer to having an assured future than they have ever been.

The business recession of the past several months has had its effects on the independents' traffic as much as on the State airlines, but as the B.I.A.T.A. year ends on June 30, this is not fully reflected in the current statistics. Next year may well show a decrease in traffic or at best, a much-reduced increase.

So far as actual effort is concerned, trooping continues to represent the largest share of the independents' work at 66% of the total passenger-miles flown; although the actual number of passengers flown on trooping went down, the passenger-miles increased because of the longer stages now being flown. This reliance upon Government trooping contracts, with their uncertain future, for so large a part of the independents' trade, is

still most unsatisfactory. Major development in other directions, however, as already noted, is now possible only with a fundamental change in Government policy; without this, increases in scheduled services can, at best, no more than match the average increase in air travel—which is now climbing back to about 10% per annum.

Expansion of the inclusive tour business in the year under review was, once again, considerable, with a 34% increase in number of passengers. This work, however, accounts for only 10% of all the independents' passengers and 8% of the passenger-miles. And in view of its highly seasonal nature, its further development by the independents seems to be possible only at the expense of low annual aircraft utilization. Some progress has been made towards obtaining approval for I.T. services for longer periods than in the past, when approval has been given for only one season at a time.

So far as other scheduled services are concerned, the figures show that all-freight services and vehicle ferry services were both recovering from set-backs suffered in the previous year. Colonial Coach services held their place, but a major reverse was suffered on internal services in the U.K., other than those to the Channel Islands and the Isle of Man. The latter two routes accounted for 89% of all passengers flown on internal services by the independents.

The cohesive theme in both the B.I.A.T.A. report and the foreword by the chairman contained therein, is the need for cheaper fares, to generate new traffic and broaden the market. The independents can point to the Colonial Coach service, inclusive tours and other categories of traffic where cheap fares have brought air travel into reach of new classes of passenger; they feel that more could be done in this direction if there was greater flexibility in establishing fares and rates for both international and domestic services. Fares, they believe, should also be related (if controlled) to types of service, comfort, speed, etc., but not necessarily to type of aircraft. On this basis, the independents would like to apply differential fares, with the object of creating a larger market.

STATISTICAL SUMMARY OF OPERATIONS OF B.I.A.T.A. MEMBERS
(July, 1957—June, 1958)

Scheduled Services

	1956–57	% change on 1955–56	1957–58	% change on 1956–57
Capacity ton-miles	35,238,000	−5	41,882,000	+20
Load ton-miles	21,934,000	+2	25,051,000	+14
Overall load factor	62.2%	—	59.9%	—
Passengers carried	690,859	+22	776,364	+12
Passenger-miles	163,231,000	+27	178,979,000	+10
Freight (short tons)	68,972	−18	86,656	+26
Freight ton-miles	6,944,000	−33	8,569,000	+23
Mail (short tons)	70	+70	44	−37
Mail ton-miles	51,000	+30	33,000	−35
Aircraft miles	11,739,000	+4	12,512,000	+7
Inclusive tours (*not included in the above*)				
Capacity ton-miles	7,469,000	+110	10,772,000	+44
Passengers	108,434	+108	144,878	+34
Passenger-miles	67,021,000	+111	97,362,000	+45

Non-scheduled and Other Operations

	1956–57	% change on 1955–56	1957–58	% change on 1956–57
Capacity, ton-miles available	111,656,000	−5	111,448,000	—
Load ton-miles performed	89,024,000	—	94,050,500	+6
Passengers carried:				
Civil	322,538	+24	307,692	−4
Military	157,035	−22	137,821	−12
Total	479,573	+4	445,513	−7
Passenger-miles:				
Civil	144,044,000	+13	112,274,000	−22
Military	516,302,000	—	729,271,000	+41
Total	660,346,000	+2	841,545,000	+27
Freight (short tons)	54,895	+24	30,030	−45
Freight ton-miles	29,980,000	—	54,547,000	+80
Aircraft miles	19,183,000	−5	22,225,907	+16

The Winter Hill Accident

THE REPORT of the public inquiry into the accident to a Bristol 170 at Winter Hill, on February 27, 1958, was issued by the M.T.C.A. last week. Owned by Silver City and operated by their associates, Manx Airlines, the Bristol 170 G-AICS was flying from Ronaldsway, Isle of Man, to Manchester with a special party; when it crashed near the summit of Winter Hill, some five miles south-east of Chorley, Lancs, 35 of the 42 persons on board were killed. The captain, Capt. E. M. H. Cairnes, and the first officer, Mr. W. H. Howarth, were among the survivors.

As usual in an accident investigation of this kind, the report gives a thorough survey of the circumstances of the flight and the events leading up to the accident. The cause of the accident was that the first officer wrongly tuned the radio compass to Oldham NDB instead of Wigan NDB, causing the aircraft to fly to the north of its required track. In the view of the Court, the captain contributed to the accident by failing to check the radio compass, which was set-up while he was absent from the flight deck.

This was, then, one of those accidents caused by an inexplicable failure of the human element in the course of a flight which was of a routine nature and presented no special problems in the cockpit. The report reveals certain irregularities and there are at least two items in respect of which it could be argued that the accident might have been avoided, although in neither case was any negligence involved.

In the first place, had the Decca Flight Log been working, it is difficult to believe that the divergence from required track would have gone unnoticed. The Decca equipment in G-AICS had in fact been unserviceable for some weeks, but had been repaired the previous day by a Decca engineer. It was not, however, set up for the flight in question and, although Mr. Howarth attempted to do so before take-off and during the flight, it was never in use.

Secondly, when the aircraft passed into the Manchester control zone, the A.T.C.O. at Preston Control, who passed the clearance on to the captain, failed to give the Barnsley QNH (barometric pressure), as he was required by regulations to do; the captain also failed to request this QNH. As it happens, this QNH was 3 millibars less than the Holyhead QNH which was used when the aircraft altimeter was adjusted at take-off. It can therefore be argued that if the new QNH had been applied, the arcraft might well have been flying some 90 ft. higher when it reached Winter Hill, and this would have been sufficient, quite fortuitously, for the accident to have been avoided.

Another point discussed at length in the report is the precise meaning of "contact" flying. When entering the Manchester Control Zone, G-AICS was given a clearance to Wigan beacon at 1,500 ft. "remaining contact." The term "contact" is not defined in any of the regulations concerning flight clearances, and the report suggests that the term should in future be defined to include some degree of forward visibility, and should not be taken to mean—as it usually is—the ability to see no more than the ground immediately below, and that perhaps only intermittently. Shortly before the accident, the aircraft was flying through patches of cloud, and probably entered solid cloud just before the impact; a more precise definition of contact flying might therefore have led to a change of altitude or course before the disaster.

On the question of beacon identification, the report notes that Wigan and Oldham—the two beacons confused by Mr. Howarth—have frequencies respectively of 316 kc. and 344 kc., and are identified by the call signs MYK and MYL. The call sign is transmitted in Morse twice each minute, so the only difference, in this case, was between the final "—.—" for K and the ".—.." for L. The report recommends transmission of the call sign at least six times a minute, and a revision of codes to make them more indicative of the name of the station itself.

Although in no way contributing to the accident there were some irregularities in the load and trim sheet, as prepared at Ronaldsway and signed by the Captain. There was also some uncertainty over the precise amount and location of the ballast on board; this ballast ("pieces of railway line") was not lashed down.

Whilst the cause of this accident is quite clear, therefore, the report is a trifle disturbing—as others have been—in its implication that rules do get broken from time to time and produce circumstances which all too easily could themselves be the cause of a disaster. The failure to pass the proper QNH seems especially disturbing—it appears that the A.T.C.O. had so interpreted the regulation as to believe he had no responsibility in this connection—since quite small errors in altitude can so quickly produce collision risks in present conditions.

Enter—The Argosy

NEW TYPES of British aeroplanes put into production are now fewer than most people would like. When production does start the aircraft is certain to be a significant one aimed at meeting clearly defined needs in World markets. The Armstrong Whitworth A.W.650 Argosy turboprop-powered "freightercoach" is just such an aeroplane and the reasons for its existence are as much common sense as the nature of its design.

Development history of the A.W.650 has been given before in these pages (May 30, 1958), but it is necessary to recount briefly the origins of the design to set the full story in proper perspective.

In 1955 project proposals were made by the Armstrong Whitworth design team at Whitley for a military general-purpose freighter. This project was the twin-engined A.W. 66 which was not of the A.W.650 twin-boom layout, but had an attenuated rear fuselage on which was mounted two very short tail booms carrying the tailplane and two fins—the empennage being of "inverted-π" configuration.

Wind-tunnel tests of a 1/30 scale model of the A.W.66 gave much useful information on the flap lift increments, tail efficiency and static stability power-on and power-off.

Later considerations of the type with civil applications in mind led to the adoption of the twin-boom layout because this permitted an unobstructed freight hold with loading doors at front and rear. The basic twin-boom layout also allows the development of a series of related aeroplanes with differently shaped and sized freight holds without compromising the rest of the structure.

It should be noted here that there are now three basic types of aeroplane in the "freightercoach" series: the A.W.650 Argosy pressurized freight or passenger type; the A.W.660 pressurized military transport with alternative tail fuselage doors for different functions, and the A.W.670 Airbus unpressurized short-haul type with wider fuselage for passengers, freight or car-ferry work.

The lay-out thus developed is a straight-forward twin-boom configuration with a high wing, twin fins and rudders, and four Rolls-Royce Dart R.Da.7/2 turboprops. Variants with two Tynes have been projected, but this engine is at a relatively early stage in its history and it would be more logical for any increases in power to be obtained by developments such as the Dart R.Da.10 engine.

With all due respect to the vital functions of the rest of the airframe, the most important part of the Argosy is the fuselage with its freight hold.

The hold has a 10-ft.-wide floor, 4 ft. from the ground, convenient for loading from a truck. The freight hold is 6 ft. 8 in. high, enclosed by a basically circular shape. The underfloor fuselage cross-section is curved for stiffness reasons, but is part of a circle of much larger diameter. A further circular profile surrounds the flight deck, giving the front fuselage a distinctive "cottage loaf" contour. Loading doors at front and rear of fuselage are side hinged for loading of freight.

The fuselage of the A.W.650 Argosy is pressurized for operation over medium ranges and the short-haul A.W.670 has a 15-ft.-wide unpressurized double-deck fuselage for motorcars (Air Ferry), freight or coach-class passengers (Airbus). In this case, the fuselage cross-section is of accentuated "cottage-loaf" shape and in side elevation the top line of the fuselage is continued back horizontally behind the flight deck to provide passenger accommodation on an upper deck above the 7-ft. high hold, which has 3,680 cu. ft. of payload-carrying volume.

For car-ferry work, six motorcars are taken in side-by-side pairs on the lower deck while the upper deck seats up to 30 passengers. For short-range passenger work 126 coach-class or 116 tourist-class seats are available. Of these, 96 are seated eight abreast in back-to-back seats with gangways on either side of central twin-seats.

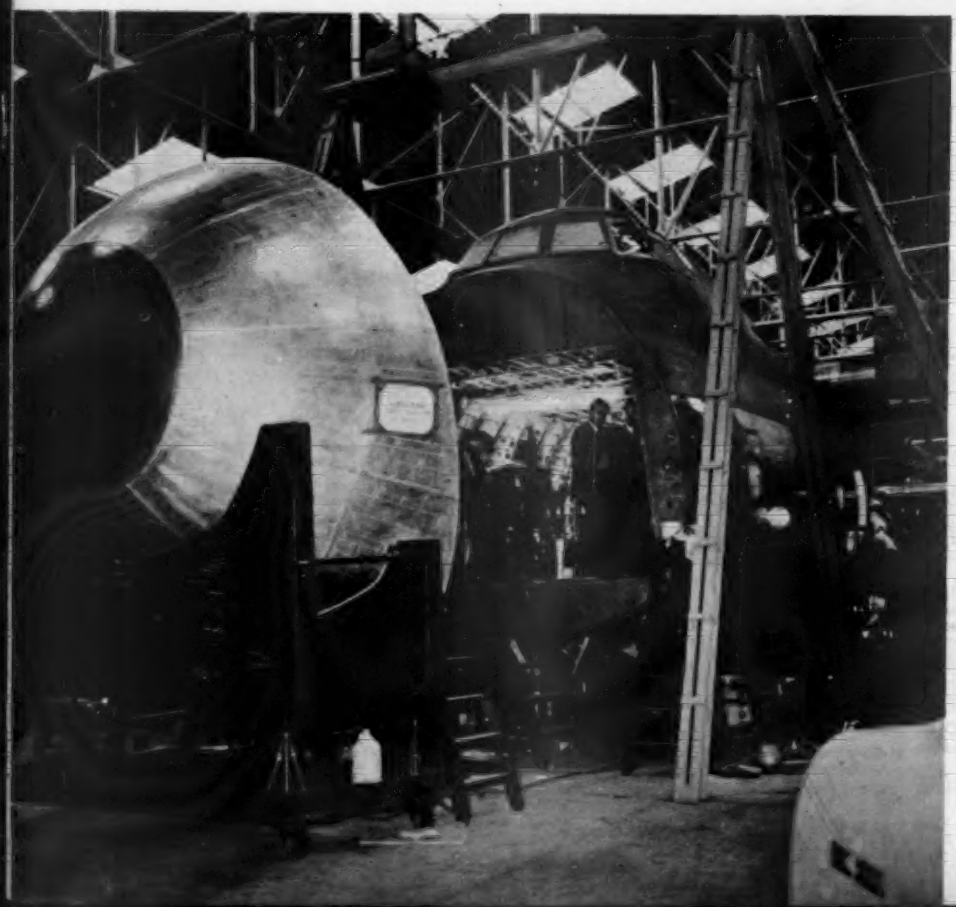
An initial batch of 10 A.W.650s and two complete airframes for testing are being built, and some details of the final assembly were given in our issue of October 10. Hawker Siddeley have invested about £10 million in the Argosy programme without waiting for orders to set the ball rolling. It is, therefore, a completely private-venture aeroplane which constitutes a major enterprise in a rapidly contracting industry.

Hawker Siddeley participation includes detail design of the tail unit, outer engine nacelles, flaps and fuselage side doors by Gloster; design of ground handling equipment by Air Service Training; design and static testing development of the wing by A. V. Roe; and handling equipment by High Duty Alloys. Ailerons have been made by G. Corner and Co., Ltd.

The first Argosy, G-AOZZ, is due to fly before the end of the year. It will not at first be fitted with full interior trim because of the temporary fitment of water-ballast tanks and automatic flight-observer equipment. Two other prototypes will follow at monthly intervals and all three will be used for obtaining an A.R.B. Certificate of Airworthiness.

The fourth Argosy will be the first of a batch of six pre-production aircraft and is scheduled to be sent off on demonstration and sales tours in the middle of next year. Appropriate modifications to meet American requirements are

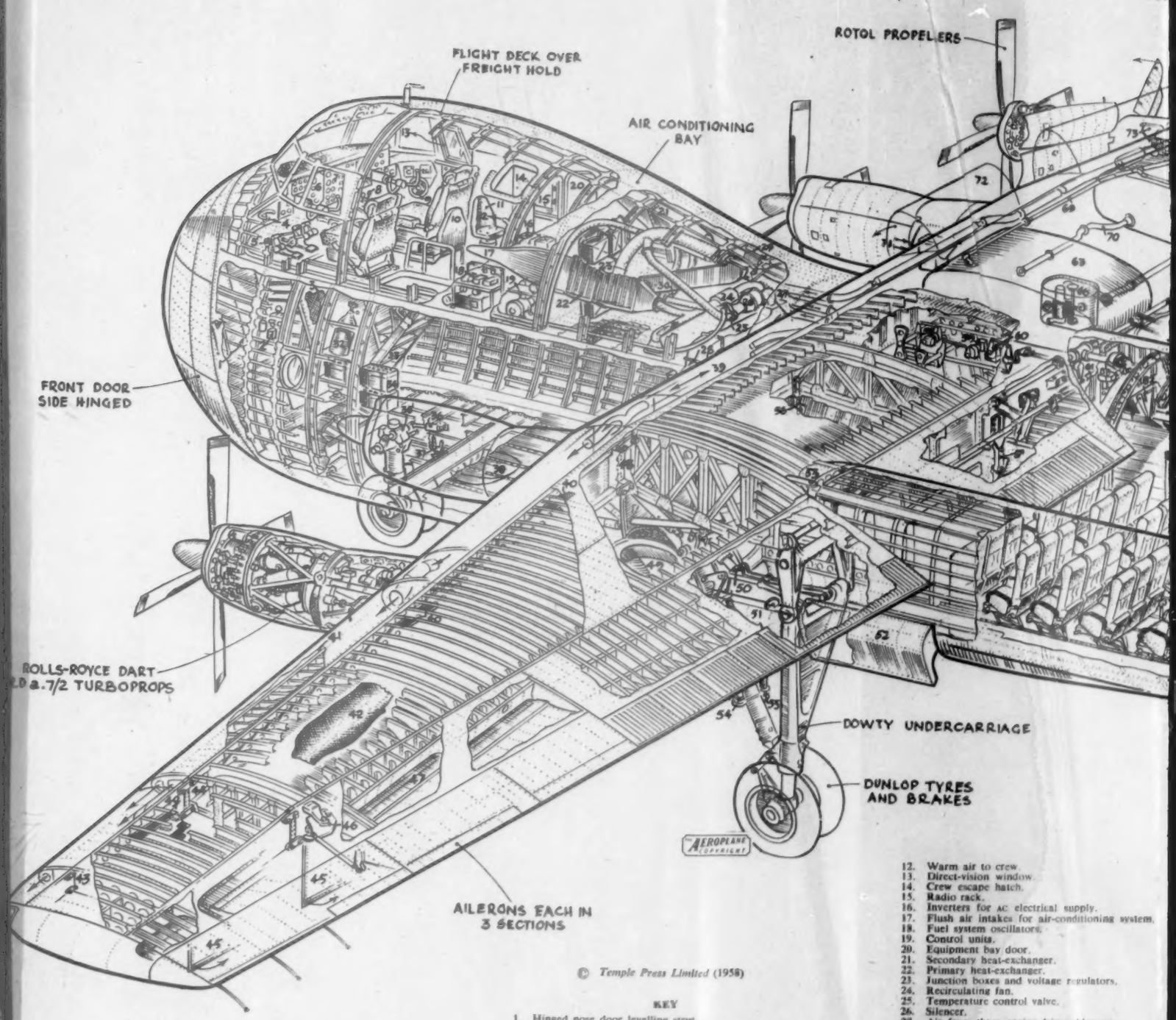
(*Continued on page* 755)



FREIGHTER FRONT.—The side-hinged nose of the Armstrong Whitworth A.W.650 Argosy forms the front loading door. Provision is made for incorporation of a radar scanner.

Photograph copyright "The Aeroplane"

THE ARMSTRONG WHITWORTH A.W.650 ARGO



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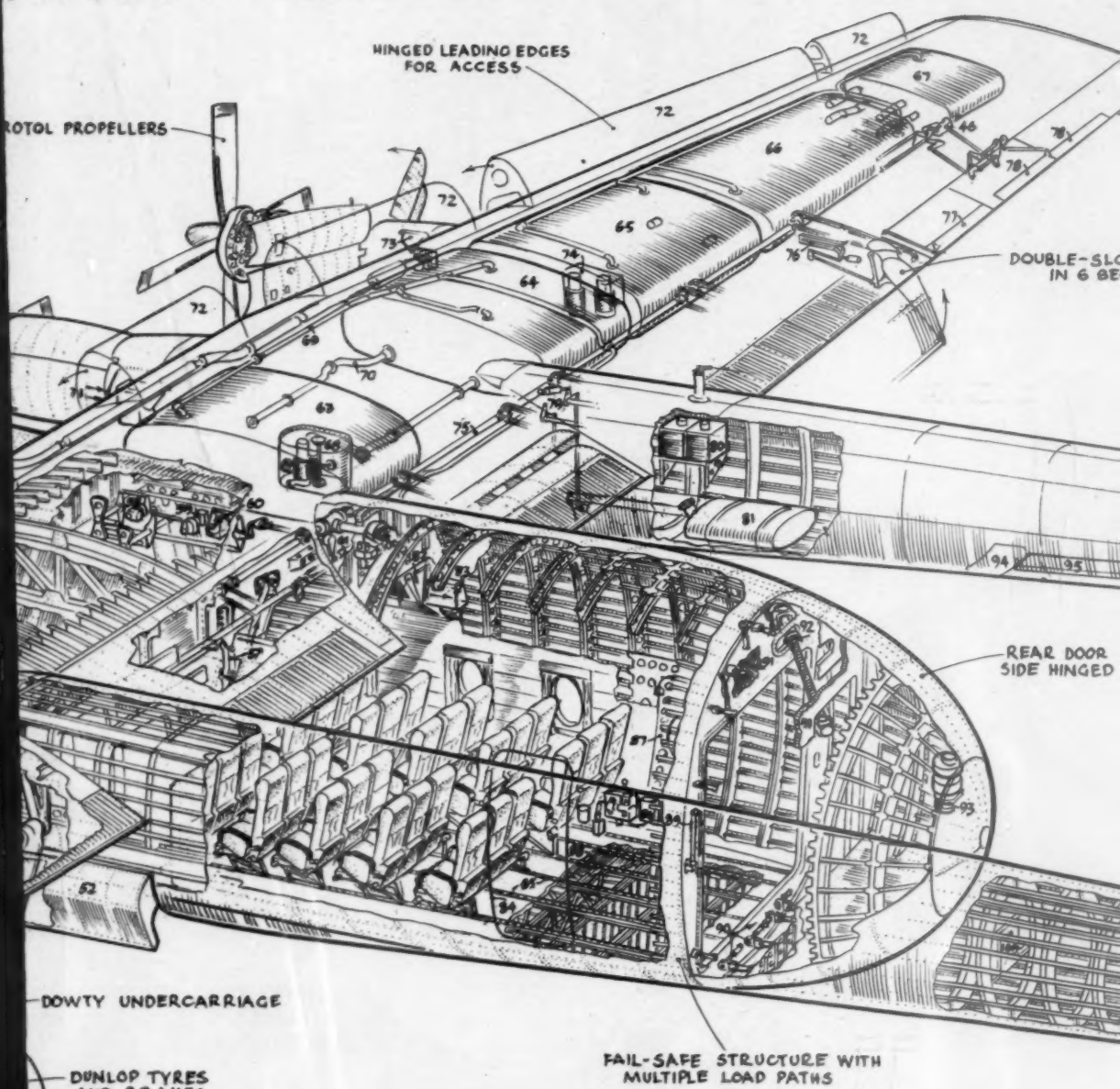
KEY

1. Hinged nose door levelling strut.
2. Nose door hydraulic lock-operating mechanism.
3. Nose door rear bulkhead honeycomb construction.
4. Warm air to pilots.
5. Rudder pedals incorporating toe brakes.
6. Flying instruments.
7. Engine instruments.
8. Central control console.
9. Nosewheel steering control handwheel.
10. Crew member's folding seat.
11. Crew member's sliding seat.
12. Warm air to crew.
13. Direct-vision window.
14. Crew escape hatch.
15. Radio rack.
16. Inverters for ac electrical supply.
17. Flush air intakes for air-conditioning system.
18. Fuel system oscillators.
19. Control units.
20. Equipment bay door.
21. Secondary heat-exchanger.
22. Primary heat-exchanger.
23. Junction boxes and voltage regulators.
24. Recirculating fan.
25. Temperature control valve.
26. Silencer.
27. Air from three engine-driven blowers.
28. Cross duct for cabin air.
29. Cooling-air flush outlets.
30. Cold-air unit.
31. Recirculating air from cabin.
32. Oxygen bottle.
33. Access ladder to crew compartment.
34. Batteries.
35. Nose undercarriage steering and centring unit.
36. Nose undercarriage operating jack.
37. Nose undercarriage up-lock mechanism.

.W.650 ARGOSY



12. Warm air to crew.
13. Direct-vision window.
14. Crew escape hatch.
15. Radio rack.
16. Inverters for AC electrical supply.
17. Flush air intakes for air-conditioning system.
18. Fuel system oscillators.
19. Control units.
20. Equipment bay door.
21. Secondary heat-exchanger.
22. Primary heat-exchanger.
23. Junction boxes and voltage regulators.
24. Recirculating fan.
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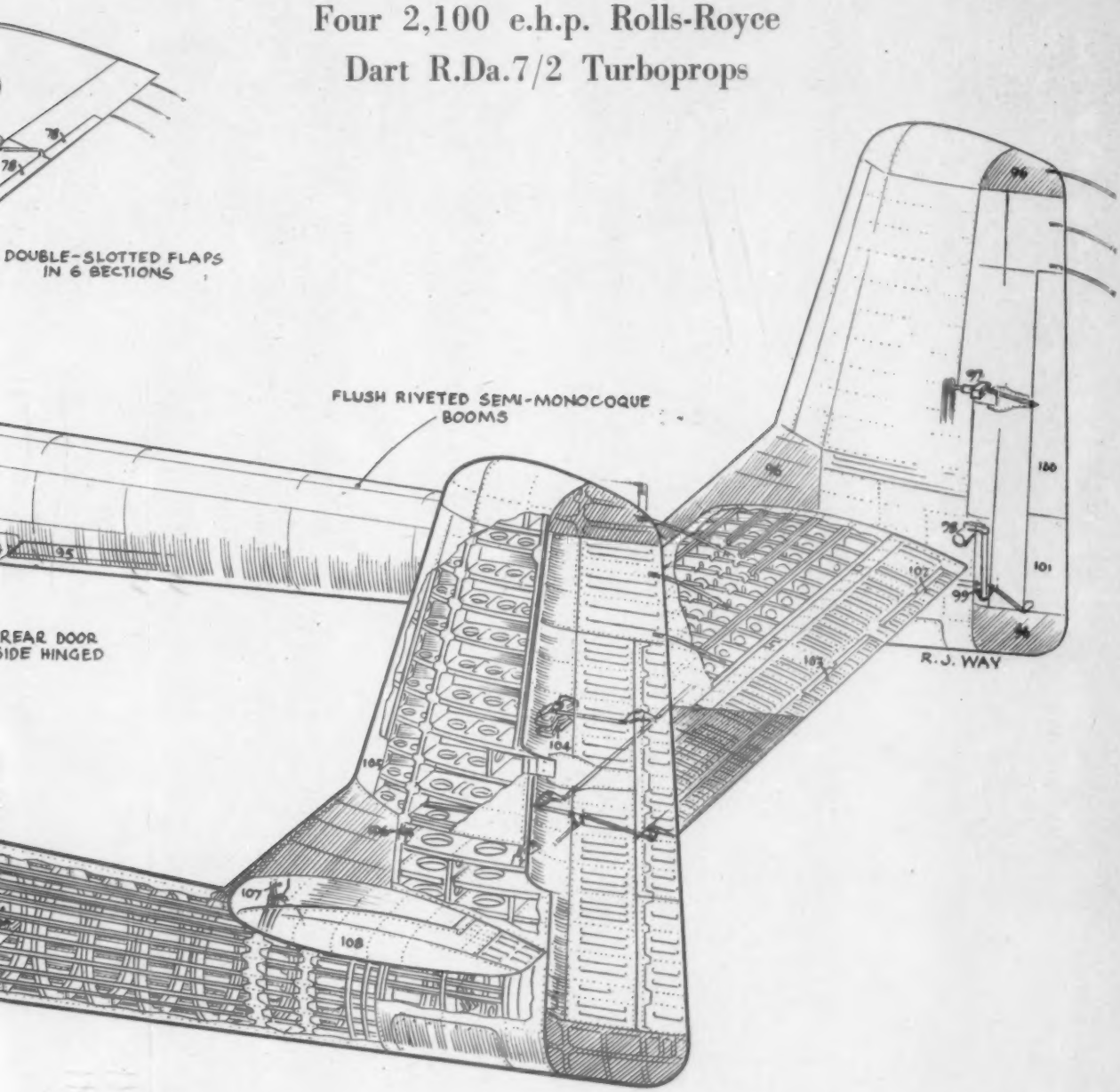
27. Air from three engine-driven blowers.
28. Cross duct for cabin air.
29. Cooling-air flush outlets.
30. Cold-air unit.
31. Recirculating air from cabin.
32. Oxygen bottle.
33. Access ladder to crew compartment.
34. Batteries.
35. Nose undercarriage steering and centring unit.
36. Nose undercarriage operating jack.
37. Nose undercarriage up-lock mechanism.
38. Nose undercarriage rear fairing.
39. Leading-edge thermal anti-icing balance duct.
40. Air outlets for leading-edge anti-icing air.
41. Leading-edge thermal anti-icing duct along complete span.
42. Tank cell.
43. Outer wing—wing-tip joint.
44. Intermediate wing—outer wing joint.
45. Underwing hinged access panels.
46. Aileron-operating and lock mechanism.
47. Aileron balance seals.
48. Centre wing– intermediate wing joint.
49. Port inner engine jet-pipe orifice.
50. Main undercarriage-operating and lock jacks.
51. Main undercarriage nose and front doors operated by radius rod.
52. Main undercarriage rear doors operated by separate jack.
53. Centre wing—boom upper joint.
54. Water-methanol filler connection.
55. Refuelling connection.
56. Centre wing — fuselage front spar joint.
57. Centre wing — fuselage rear spar joint.
58. Rudder servo motor.
59. Aileron servo motor.
60. Elevator servo motor.
61. Aileron-operating push-rod.
62. Flap-operating motor.

Four 2,100 e.h.p. Rolls-Royce Dart R.Da.7/2 Turboprops



63. Fuel tank No. 1 } inner engines
64. Fuel tank No. 2 }
65. Fuel tank No. 3 } outer engines } total capacity 3,300 Imp. gal.
66. Fuel tank No. 4 }
67. Fuel tank No. 5 }
68. Twin fuel pumps in drain box with three manually operated valves.
69. Fuel tanks vent pipe.
70. Inner fuel tanks interconnecting pipe.
71. Thermal anti-icing heat-exchanger on inner engines only.
72. Hinged leading edge forward of front spars.
73. Air blowers (except starboard inner) to air-conditioning primary heat-exchanger.
74. Outer fuel tanks twin pumps.
75. Flap-operating torque tube.
76. Flap-operating mechanism (six units each side).
77. Aileron geared tab.
78. Aileron spring tabs.
79. Operating jack for main undercarriage rear doors.
80. Electrical de-icing system voltage-controllers.
81. Water-methanol tank (water-methanol and hydraulic header tanks in port boom).
82. Folding luggage rack.
83. Air-conditioning duct.
84. Port entry door.
85. Seat and freight lashing members (six).
86. Hinged rear door hydraulic lock-operating mechanism.
87. Starboard entry door.
88. Redux-bonded floor panels.
89. Rear door levelling strut.
90. Rear door hydraulic lock jacks.
91. Rear door bulkhead honeycomb construction.
92. Rear door manually operated screw-jack (nose cap similar).
93. Pressure cabin air discharge valve.
94. Boom access door.
95. Boom walk-way.
96. Glass-fibre fairings.
97. Rudder trim tab screw-jack.
98. Rudder-locking mechanism.
99. Rudder-operating mechanism.
100. Rudder trim tab.
101. Rudder spring tab.
102. Elevator trim tab.
103. Elevator spring tab.
104. Elevator-operating mechanism.
105. Napier Spraymat electrical de-icing on fin and tailplane leading edges.
106. Upper fin — stub fin joint.
107. Stub fin — boom joint.
108. Elevator horn balance.
109. Fairleads in booms for flying control cables.

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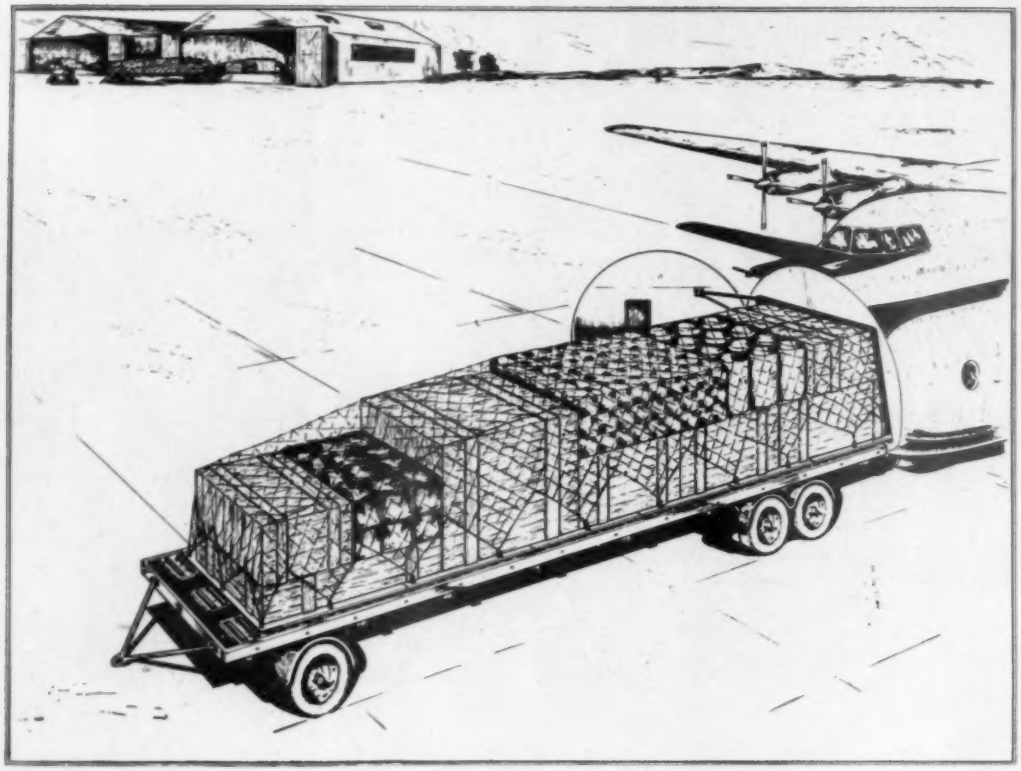
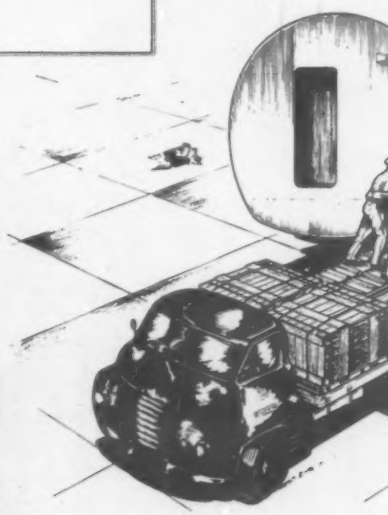
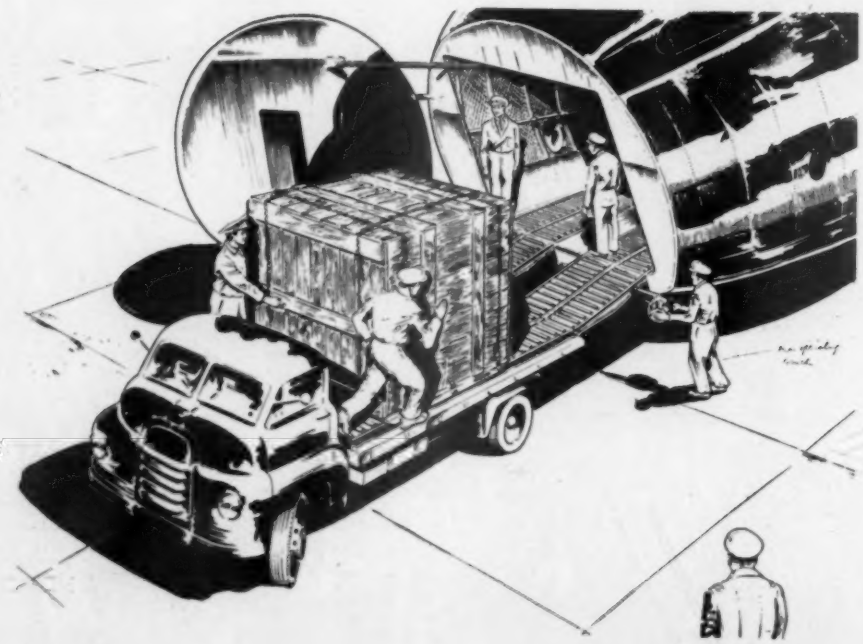


A loaded trailer with roller-floor at the same height as the Argosy floor allows very rapid loading of the freight hold, the loaded pallet being winched into the 3,680-cu. ft. hold.



Man-handling of packing cases presents little difficulty when truck and aircraft both have roller-floors.

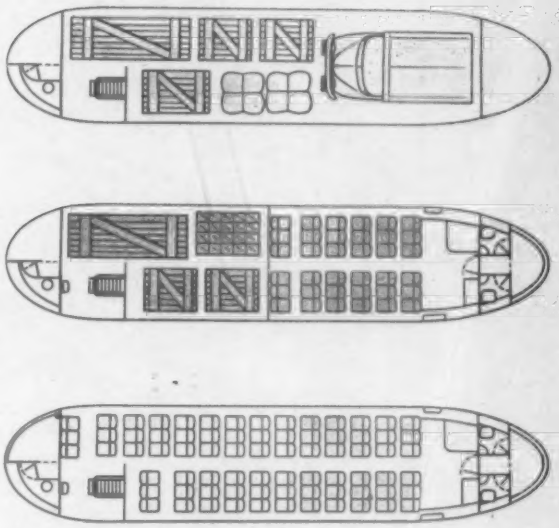


Left, a large case is manœuvred into position for winching into the Argosy hold.

Right, the rol
removed and
nor

Loading the Argosy

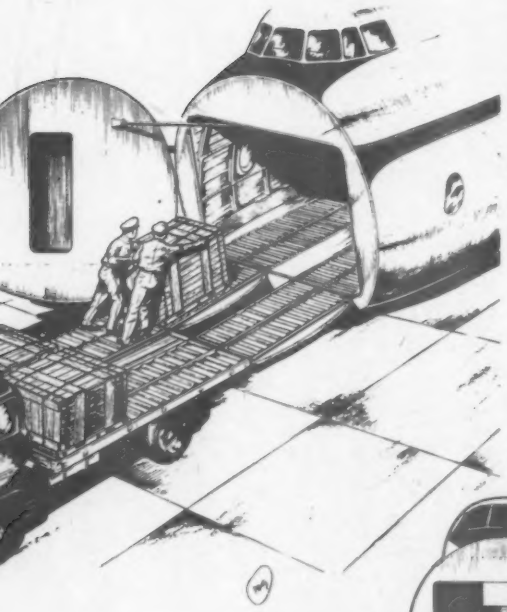
Various schemes for loading the Argosy can be used, according to the needs of the operator. On the right are three layouts for freight and passenger accommodation. The other four sketches show a freight-loading system using a roller-floor and bridge or ramp for varying truck-bed heights. This system has been developed by Armstrong Whitworth for the Argosy, but others such as the Cargon system can be incorporated in the aircraft if required.



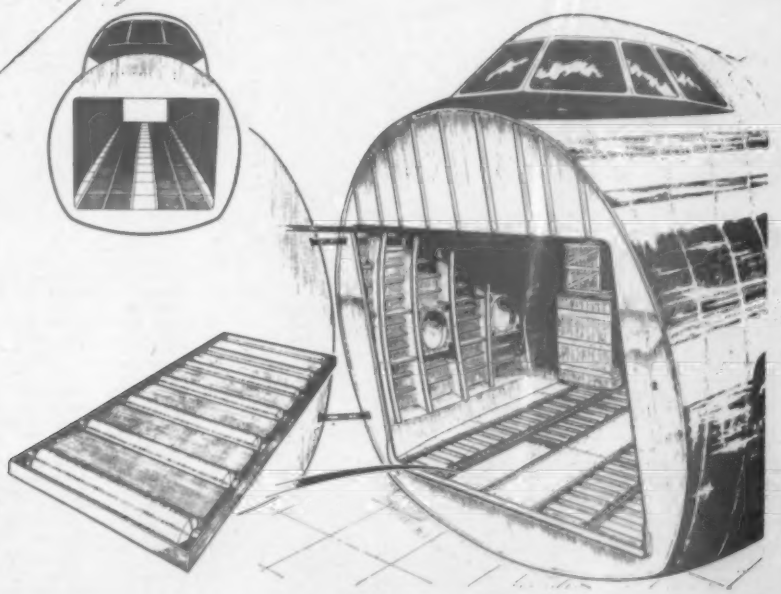
Top, a pure freight layout with 426 sq. ft. of floor area.

Centre, a mixed freight and passenger layout.

Bottom, a 75-passenger version with toilet and galley services.



uvred into
the Argosy



Right, the roller-floor can be easily removed and inverted to form a normal surface.

ARGOSY SUPPLIERS AND SUB-CONTRACTORS

A

A.B. Metal Products, Ltd. (rotary switches); A.E.I. Lamp and Lighting Co., Ltd. (electrical fittings); Accles and Pollock, Ltd. (steel tubes); Acton Bolt, Ltd. (bolts, nuts and screws); Aero Controls, Ltd. (miscellaneous items); Airscrew Co. and Jicwood, Ltd. (fan units); Aircraft Materials, Ltd. (bolts, nuts and screws); Aluminium Wire and Cable, Ltd. (light alloy wire); George Angus and Co., Ltd. (seals); Appleby and Ireland, Ltd. (pressure gauges); B. Attewell and Sons, Ltd. (aluminium); Avery-Hardoll, Ltd. (miscellaneous items); Aviation Developments, Ltd. (Pip pins); Avo, Ltd. (Avometers).

B

B.B. Chemical Co., Ltd. (sealing components); B.X. Plastics, Ltd. (P.V.C. sheet); Belling and Lee, Ltd. (fuses); Birmetals, Ltd. (light-alloy bar and tubes); Birmingham Aluminium Casting (1903) Co., Ltd. (castings); The Birmingham and Blackburn Constructions Co., Ltd. (dummy main undercarriage legs); Thomas Bolton and Sons, Ltd. (copper sheet and bar—brass sheet); Thomas Boorn and Co., Ltd. (flexible hose); James Booth and Co., Ltd. (light-alloy strip, bar and tube); Brett's Stampings Co., Ltd. (steel forgings); Brifex, Ltd. (furnishings); British Aluminium Co., Ltd. (light alloy and aluminium sheet and tube); British Insulated Callender's Cables, Ltd. (cables); The British Oxygen Aro Equipment, Ltd. (oxygen equipment and crew's emergency oxygen system); British Plywood Manufacturers, Ltd. (plywood); British Refrasil Co., Ltd. (insulation blankets); British Ropes, Ltd. (nylon rope); British Thomson-Houston Co., Ltd. (electrical items); British Timken, Ltd. (bearings); British Wire Products, Ltd. (miscellaneous items); Brown Bayley Steels, Ltd. (steel bar); Brown Brothers (Aircraft), Ltd. (bolts, nuts and screws); Brunton's (Musselburgh), Ltd. (cables and cable assemblies); The Brush Electrical Engineering, Ltd. (fuses); The Budenburgh Gauge Co. (gauges); A. F. Bulgin, Ltd. (lamp holders); Burgess Products, Ltd. (air silencer and micro-switch).

C

Cambridge Instruments, Ltd. (test sets); Camerer Cuss, Ltd. (elapsed time and time of flight clock); Cannon Electric (G.B.), Ltd. (plugs and sockets); C. G. Carlisle and Co., Ltd. (stainless steel bar); Cementation (Muffelite), Ltd., (Barrymount Isolaters); Chelton (Electrostatics), Ltd. (electrical items); CIBA (ARL), Ltd. (Redux bonding); Charles Clifford, Ltd. (brass and copper bar); H. Comoy and Co., Ltd. (inserts); G. Corner, Ltd. (ailerons); Cornercroft, Ltd. (machining of items); W. B. Cull and Sons, Ltd. (steel forgings); C.W.C. Equipment, Ltd. (switches).

D

The Dart Spring Co., Ltd. (springs); The Decca Navigator Co., Ltd. (navigation equipment, etc.); Delaney Gallay, Ltd. (heat exchangers and toilets); Dependable Springs and Pressings, Ltd. (springs); Docker Brothers (protective finishes); Dowty Equipment, Ltd. (undercarriage equipment); Dowty Nucleonics, Ltd. (magnetic indicators and switches); Dowty Seals, Ltd. (seals); Dover, Ltd. ("Doverite" smooth matt finish); Dunlop Rubber Co., Ltd. (Aviation Division) (sections, sheet, strip and hose, wheel and brake equipment, rubber seals).

E

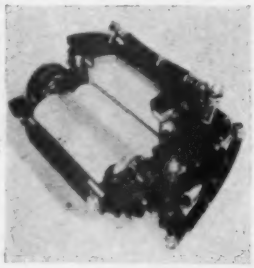
Ekco Electronics, Ltd. (loan of control unit and drift indicator); Elliott Bros. (London), Ltd. (electrical equipment); English Steel Rolling Mills Corporation, Ltd. (steel bar and forgings); Erith Engineering, Ltd. (manufacturing of gearbox and machining of items).

F

Fairey Aviation, Ltd. (miscellaneous items); Ferodo, Ltd. (Ferodo); Ferranti, Ltd. (transformers, etc.); Denis Ferranti Meters, Ltd. (miscellaneous items); Films and Equipment, Ltd. (miscellaneous items); Fireproof Tanks, Ltd. (tanks); Firth Cleveland Instruments, Ltd. (tank equipment and miscellaneous items); T. F. Firth and Sons, Ltd. (carpets); Thos. Firth and John Brown, Ltd. (steel bar); Firth-Vickers Stainless Steels, Ltd. (stainless-steel sheet and strip, centri-spun castings); W. T. Flather, Ltd. (steel bar); Flight Refuelling, Ltd. (electrical items); Fothergill and Harvey (Sales), Ltd. (glass-cloth); Samuel Fox and Co., Ltd. (stainless-steel sheet).

G

G.Q. Parachute Co., Ltd. (safety harnesses); General Electric Co., Ltd. (miscellaneous items); Gent and Co., Ltd. (bells); Gloster Aircraft Co., Ltd. (machining); Sir George Godfrey and Partners, Ltd. (water extractor and cold-air unit); John Gosheron and Co., Ltd. (tapes); Govan Shafting and Engineering Co., Ltd. (mild-steel bar); Graseby Instruments, Ltd. (rate gyro type G.W.3); Graviner Manufacturing Co., Ltd. (fire detection equipment); Greenwich Plastics, Ltd. (furnishings); Griflex Products, Ltd. (miscellaneous items); Guest, Keen and Nettlefolds (Midlands), Ltd. (bolts, screws and nuts); Glynhir Tinplate Co., Ltd. (mild-steel sheet).



A sectioned cabin blower unit of the type supplied by Sir George Godfrey and Partners for the Argosy.

H

Hall and Hall, Ltd. (sealing rings, strip and sheet rubber); Harley Aircraft Landing Lamps (retractable landing light); Hellermann, Ltd. (cable markers); Hendrey Relays, Ltd. (relays); Henley's Telegraph Works Co., Ltd. (cables and equipment, wires); W. Henshall and Sons, Ltd. (food containers, bar equipment, refrigerators); Hickman, Ltd. (distance tubes); High Duty Alloys, Ltd. (light-alloy sheet, bar, sections forgings and castings); High Pressure Components, Ltd. (miscellaneous items); H. M. Hobson, Ltd. (flap operating gear); Hoffman Manufacturing, Ltd. (ball races); Honeywell-Brown, Ltd. (potentiometers); A. H. Hunt (Capacitors), Ltd. (capacitors).

I

Imperial Chemical Industries, Ltd. (Metals and Plastics Divisions) (Perspex, Vynide-furnishing, titanium); Integral, Ltd. (emergency power pack); Ioco, Ltd. (plastics).

J

E. J. Jack, Ltd. (eye ends); H. W. Jones (Tools), Ltd. (tools); W. E. Jones, Ltd. (jigs, fixtures).

K

J. F. Kenure, Ltd. (luggage netting); King Aircraft Corporation (miscellaneous components and items); Kiveton Park Steel and Wire Works, Ltd. (steel bar); Richard Klinger, Ltd. (Klingerit, gaskets).

L

Linen Thread Co., Ltd. (cords and threads); Linread, Ltd. (rivets, bolts and nuts); Lockheed Hydraulics, Ltd. (hydraulic hand pumps, filters); Joseph Lucas (Gas Turbine Equipment), Ltd. (fuel control units).

M

M.B. Metals, Ltd. (miscellaneous items); Magnetic Devices, Ltd. (miscellaneous items); Manganese Bronze and Brass, Ltd. (miscellaneous items); Marconi's Wireless Telegraph Co., Ltd. (dual automatic direction finding equipment); Maricon, Ltd. (miscellaneous items); Marston Excelsior, Ltd. (fuel and air heat-exchangers); Measuring Instruments (Pullin), Ltd. (miscellaneous items); Mechanism, Ltd. (counters); Midland Aeroquipment, Ltd. (miscellaneous); Mollart Engineering, Ltd. (miscellaneous).

N

D. Napier and Son, Ltd. (Spraymat application of tail unit components); National Physical Laboratory (wind-tunnel model tests); Negretti and Zambra, Ltd. (torquemeter, precision pressure gauges); Neil Tool Co., Ltd. (tools, main assembly jigs); Newton Bros. (Derby), Ltd. (voltage regulators); L. H. Newton and Co., Ltd. (bolts and screws); Normalair, Ltd., (pressure-controller, altitude selector); Norman Engineering, Ltd. (machining); Northern Aluminium Co., Ltd. (forgings, sheet, extrusion, castings); Norstel, Ltd. (special units); Northern Rubber Co., Ltd. (miscellaneous items); N.S.F., Ltd. (switch lever).

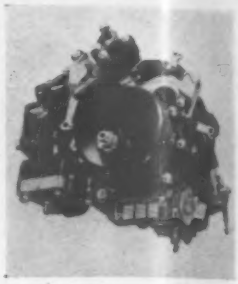
P

Philips Electrical, Ltd. (miscellaneous items); Pianoforte Supplies, Ltd. (hinges); Phoenix Telephone and Electric Works, Ltd. (warning lamp filaments); The Pittsburgh Plate Glass Co., Ltd. (windscreen front panels Nesa glass); Plannair, Ltd. (blower units); Plessey Co., Ltd. (miscellaneous and electrical items); Polypenco, Ltd. (nylon rod, plate and tube); A. Poole and Sons, Ltd. (springs); Power Controls, Ltd. (miscellaneous items); Pulsometer Engineering Co., Ltd. (fuel pumps); Pyrene Co., Ltd. (impact crash switch).

R

Ransome and Marles Bearing Co., Ltd. (ball races); Regent Small Tools Ltd. (machining); Renold Chains, Ltd. (chain assemblies); Reynolds Tube Co., Ltd. (steel tubes); J. W. Roberts, Ltd. (Ferrobestos); A. V. Roe and Co., Ltd. (tank skin attachment angles, wind-tunnel tests, structures for wings, structural test specimens, design work on wings); Rolls-Royce, Ltd. (Dart engines); Rose Bros. (Gainsborough), Ltd. (bearings); Rotherham Forge and Rolling Mills Co., Ltd. (steel sheet and strip); Rotax, Ltd. (electrical equipment); Rotol, Ltd. (propellers); Rubery Owen and Co., Ltd. (bolts, nuts and screws); L. A. Rumbold, Ltd. (first and second pilot's seats).

Normalair's H-type pressure controller used in the air-conditioning system.



A Lucas combined control unit for fuel flow.

S

Sangamo Weston, Ltd. (miscellaneous); Santon, Ltd. (miscellaneous); Saunders-Roe, Ltd. (ditching tests); Saunders Valve Co., Ltd. (valves); SPE Co., Ltd. (fuel booster pump, water-methanol pump); Siebe Gorman, Ltd. (miscellaneous items); Silentbloc, Ltd. (Silentbloc flexible mountings); Simmonds Aerocessories, Ltd. (self-locking nuts); Short Bros. and Harland, Ltd. (miscellaneous items); Skefko Ball Bearings Co., Ltd. (bearings); Smiths Aircraft Instruments, Ltd. (electrical instruments); Southalls (Birmingham), Ltd. (wadding); Stampings Alliance, Ltd. (light alloy forgings); Standard Telephones and Cables, Ltd. (electrical instruments); Sterling Metals, Ltd. (castings); J. Stone and Co. (Deptford), Ltd. (vapour thermostats and relays).

T

Talbot Stead Tube Co., Ltd. (stainless-steel tube); Tecalemit, Ltd. (water-methanol filters); Teddington Aircraft Controls, Ltd. (electric instruments); Teleflex Products, Ltd. (miscellaneous); Telegraph Construction and Maintenance, Ltd. (electrical items); Thorn Electrical Industries, Ltd. (miscellaneous items); H. Tinsley, Ltd. (strain gauges); Torrington Co., Ltd. (bearings); Transport Seating, Ltd. (passenger seats); Triplex Safety Glass Co., Ltd. (windscreen side panels); Tufnol, Ltd. (Tufnol); Tungum Co., Ltd. (tubes).

U

Ultra Electric, Ltd. (communication control systems); Unbrako Socket Screw Co., Ltd. (special screws).

V

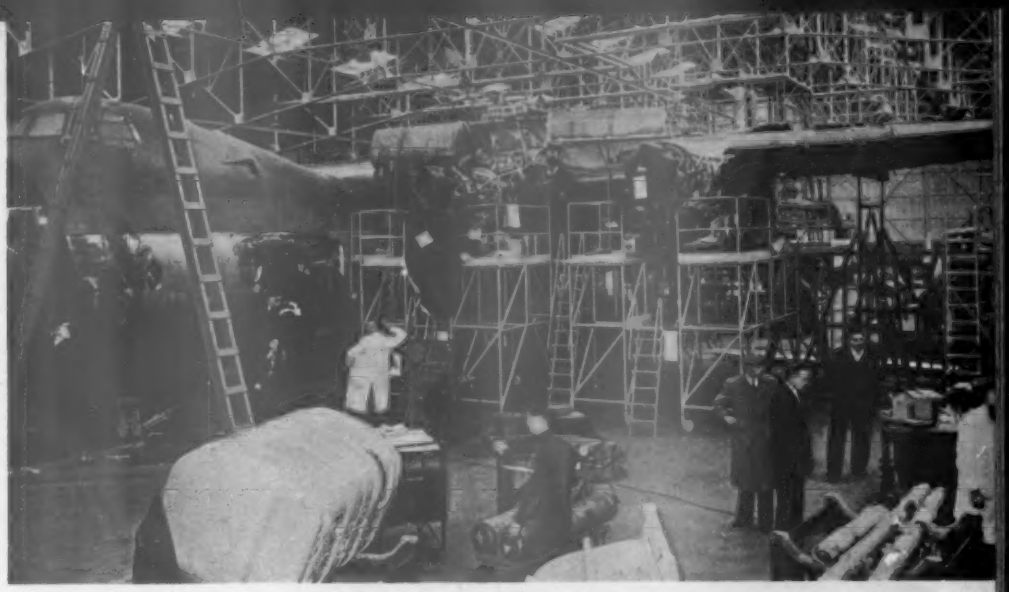
Vandervell Products, Ltd. (bearings); Varley Dry Accumulators Ltd. (accumulators); Venner, Ltd. (emergency lighting units); Vickers-Armstrongs (Engineers), Ltd. (inboard and outboard powerplants); Vokes, Ltd. (Mille-Vee filters).

W

James Walker and Co., Ltd. (jointing); Walsh and McCrea (Halifax), Ltd. (curtains); Welwyn Electrical Laboratories, Ltd. (resistors); Western Manufacturing (Reading), Ltd. (electro film on items); Wilkinson Rubber Linatex, Ltd. (Linatex); Benjamin Whitaker, Ltd. (aluminium); Wrights' Ropes, Ltd. (cables and cable assemblies).

Y

Yorkshire Imperial Metals, Ltd. (brass tubes).



ARGOSY ASSEMBLY.—Final assembly of the A.W.650 is at Bitteswell, seen here. Main production is at Baginton and the wings are made at Woodford.

Photograph copyright "The Aeroplane"

(Continued from page 748)

being incorporated in the three prototypes to obtain full A.R.B. and C.A.A. approval by mid-1960.

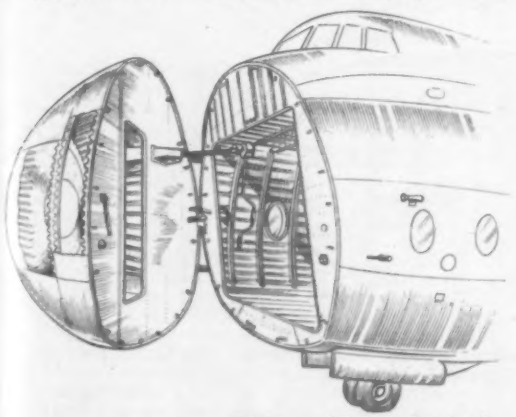
Systems and Services

No less vital than any other part of the design of a new aeroplane are the various systems and services in the airframe. The faultless functioning of these is a most important aspect of service of the aircraft with an operator, and in developing a new design great attention must be paid to trouble-free operation. With this in mind, the systems of the A.W.650 are of great interest. An important aspect is that products of proven reliability have been chosen, rather than new items.

Ten flexible bag tanks in the wings carry the total fuel supply of 3,300 Imp. gal. for the four 2,100-e.h.p. Rolls-Royce Dart R.Da.7/2 Mk. 526 turboprops. These tanks are housed between light alloy inner skins. The three outer bag tanks of each wing are inter-connected by dual pipelines and supply fuel to the outboard engines. The two inner tanks in each wing are also interconnected and feed the inboard engines. Electrically operated low-pressure pumps (mounted in pairs in the inboard tank of each tank group) deliver fuel to the engine-driven high-pressure fuel pumps. Switches for these pumps are mounted on the fuel-gauge panel on the starboard instrument panel. On leaving the tanks, fuel passes through low-pressure cocks (controlled by switches on the central control console) to the engine high-pressure fuel cocks which are operated by a set of four levers on the console.

Throttle levers are duplicated, each set being mounted on either side of the console. Four fuel flow-meters on the instrument panel indicate the rate of fuel flow to each engine and show the total amount used. There is a capacitance-type fuel gauge system which registers the tank contents on gauges on the starboard instrument panel.

Normally, each of the four Darts has a separate fuel supply, but the delivery lines between engines can be interconnected—if necessary—to supply any engine from any system by closing the appropriate fuel transfer switches. Any system can be isolated by switching off the appropriate fuel pumps and closing the supply line by switching off the appropriate switch on the console.



Drawing copyright "The Aeroplane"

NOSE ENTRY.—Front and rear ends of the Argosy are formed by loading doors which are wound-opened manually. The extreme nose is shown cutaway to reveal the front pressure bulkhead.

When necessary, fuel balancing can then be effected by operation of the transfer switches. Warning indicators for each engine supply line are mounted on the fuel instrument panel and glow red if the supply to an engine fails.

Atmospheric vent pipes are taken from the top of each fuel tank and float-valves are used to prevent loss of fuel. Drainage for engine wet-starts is allowed for by a drain sump below each engine nacelle which automatically "bleeds" to atmosphere at take-off. Fuel-trim switches are on the central console for control of engine turbine inlet temperature and are grouped with the engine controls.

Hot air tapped from each engine compressor is directed to a Marston Excelsior de-icing heater muff around the appropriate fuel pipe just upstream of the filter. Differential-pressure switches give warning of ice formation by operating warning lights as soon as ice forms in the filters and restricts fuel flow.

Water-methanol tanks are fitted in each tail boom and one feeds each pair of engines when it is desired to restore engine take-off power under conditions of high ambient temperature. Each engine is fed by a separate pump and the four pumps are each controlled by a switch on the instrument panel.

Each main undercarriage leg carries a selective pressure refuelling/defuelling point. Tank selection is obtained by operation of a small switch panel on the inside face of each main undercarriage fairing door.

High-pressure fuel pumps in the Argosy are by Joseph Lucas (Gas Turbine Equipment), Ltd., and the rated flow of each GB.205 pump is 438 g.p.h. at a rated speed of 4,000 r.p.m. and a pressure of 2,000 lb./sq. in. Pacitor fuel gauges are used.

The Lucas combined control unit, or simple flow control, consists of a throttle-valve, shut-off cock, low-pressure filter and altitude-responsive flow control in one housing. An important feature of the control is the reduction in pump pressure at part-open throttle settings, the pump pressure being never more than about 200 lb./sq. in. above burner pressure.

Engine fire-warning lights are operated by a continuous resetting detector system. Fire in an engine bay is detected by a Graviner Firewire detector element and there are two fire extinguisher spray rings around each engine. Detection of fire inside the powerplant is by a flame switch in the engine breather.

The fire zones are separated by fireproof bulkheads; an engine bulkhead around the compressor casing separates the combustion system from fuel-metering equipment and an airframe bulkhead isolates the engine from the mainplane. Around the jet pipes are British Refrasil fireproof insulating blankets inside a light-alloy shroud.

Inside each engine nacelle is an electrically operated twin-head engine fire extinguisher bottle containing methylbromide. The bottle can be discharged to either the inboard or outboard engine, as selected.

Hydraulic System

This is a simple 3,000-p.s.i. system for operation of undercarriage, undercarriage doors, nosewheel steering, brakes and wing flaps. Three engine-driven pumps generate hydraulic pressure, one driven by each port engine and the third by the starboard inner engine. Any two pumps give enough pressure for normal operation of the system.

The hydraulic fluid header tank for the pumps is in the port tail boom, aft of the wheel well. When flying in low-temperature conditions the tank is pressurized at 10 to 12 lb./sq. in.

from the cabin heating system. Choking of the blowers builds up pressure in the line and boosts the pressure in the header tank.

Fluid is pumped to high-pressure filters through a pressure-regulating cut-out switch. A small buffer accumulator smoothes out pulses to prevent the switch from constantly cutting in and out. Pumps, accumulators and cut-out are all of Lockheed manufacture. A hand pump is used for pressurizing the system when on the ground. This can be used for remotely priming the header tank.

Largest operating jacks in the hydraulic system are those for raising the undercarriage legs. The Dowty undercarriage is designed to be lowered by gravity for simplicity and safety, it also has the effect of reducing the size of the header tank. In addition to the undercarriage gear, most of the hydraulic components are also of Dowty design.

Nosewheel steering is available when the weight of the aircraft on the undercarriage completes an electrical circuit to the steering valve which can be energized when either steering wheel is pressed down. When undercarriage retraction is selected, a pressure-regulating valve allows hydraulic pressure to centralize the nosewheel assembly before retraction starts.

Flap-operating shafts are actuated by a Hobson unit, powered by two Integral hydraulic motors. The shafts are driven through a worm-and-wheel reduction gear by two swashplate motors, one for normal and one for emergency use.

Front and rear freight doors and windscreen wipers are operated by separate self-contained hydraulic systems. The Dunlop Maxaret brakes are toe-operated.

A hydraulics-servicing bay is on the port underside of the fuselage where all accumulators can be charged, circuits de-pressurized, the header tank topped-up and access gained to ground-test connections. The two brake accumulators (normal and emergency) are charged at 1,550 lb./sq. in. and then built up to 3,000 lb./sq. in. by the system.

For emergency use there is an Integral power pack consisting of an electric motor, pump and hydraulic fluid reservoir. It supplies hydraulic pressure for flap and undercarriage operation. There is also an accumulator for emergency operation of wheel brakes.

Electrical and Ice-Protection Systems

Four Rotax 6-kW. 28-V. engine-driven DC generators running in parallel comprise the main generator system of the Argosy.

The AC power requirements for radio, radar and flying instruments are supplied by Rotax inverters. Heavy power supplies for electrical de-icing of tail surfaces, air intakes and propeller-blades is from four Rotax 22-kVA alternators. Rotax are also responsible for switchgear, control and circuit-protection units.

Engine-starting is by electric motors, with overspeed protection for the starter motors. Ignition is by twin high-energy igniters. Starting is usually from ground supply although one or two starts could normally be made from the aircraft batteries. With one engine running, the other three can quickly be started also because of the power then generated.

The four 22-kVA alternators are each driven by an engine and are responsible for de-icing their own engine. Windscreen heating is taken from No. 1 alternator, Nos. 3 and 4 acting as stand-bys. The remainder of the alternator supply is for the Napier Spraymat protection of the tailplane and fin leading edges, and the elevator horns.

Wing leading edges are thermally anti-iced by engine-bleed air fed to corrugations inside the first 12% of chord. A Delaney Gallay heat-exchanger inboard of each inboard engine takes in ram air which is heated by cross-flow of exhaust gas before being ducted to the leading edges.

There is a self-contained system for fuel filter de-icing on each engine. If ice begins to restrict fuel flow, hot air from the engine compressor is supplied to a heater muff around the fuel pipe immediately upstream of the filter.

Air Conditioning and Pressurizing

Cabin air for the Argosy is from three Type 15 Godfrey blowers driven by the two port engines and the starboard outer Dart. Any two blowers can maintain correct pressure.

A Normalair Type H unit controls pressurization, working in conjunction with three discharge valves in parallel. The discharge valves also act as automatic safety valves, in preventing over-pressurizing of the cabin, and as inward pressure-relief valves, to limit any negative pressure-differential to a safe value.

Control of cabin pressure is completely automatic, cabin altitude being governed by aircraft height, while the rate of change of cabin height is automatically restricted to an acceptable figure.

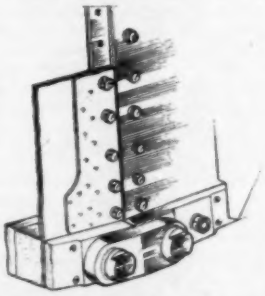
Arrangement of the discharge valves in parallel, instead of in series as was once customary, and improved design of the valves considerably reduces back-pressure in the system. This virtually eliminates surges in cabin pressure and thereby gives greater comfort for the passengers.

Should any of the discharge valves fail in the open position, the position of the remaining valves is automatically adjusted to compensate. If any valve fails in the closed position, the remaining valves can pass the full cabin air flow whether they are acting as discharge or safety valves.

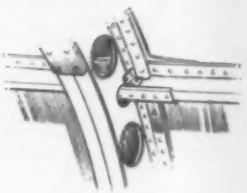
Heated or cooled air is supplied through main distribution ducts to the passenger cabin and flight deck. Heat generated by the blowers is used for heating. Cooling is effected by diverting air from the blowers through two heat-exchangers and a Godfrey cold-air unit. Cooling system equipment is located behind the flight deck with an Airscrew Co. and Jicwood recirculation fan and one of the air discharge valves. The other two discharge valves are mounted one in each freight door. Flush-type intakes for cooling air are located on each side of the upper fuselage, behind the flight deck.

Wing, Booms and Tail Unit

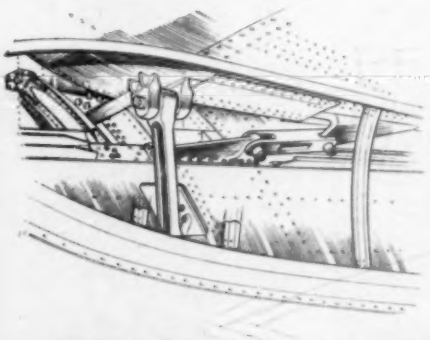
In essence, the Argosy airframe consists of a wing, tail boom and tail-unit structure from which is hung a payload-carrying fuselage. When project studies were being made for the A.W.650 it became evident that a suitable basic wing structure



Below, a typical stringer—frame joint of the multiple load-path fuselage structure.



Above, centre wing—intermediate wing joint at the front spar.



Wing—fuselage joint at the front spar

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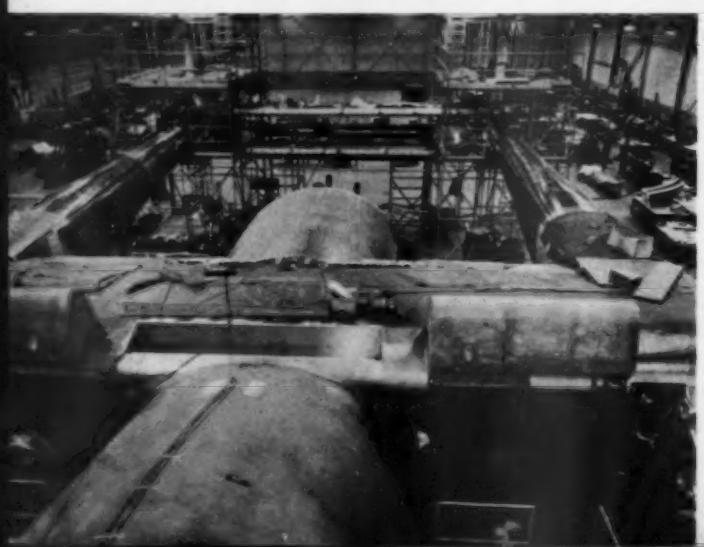
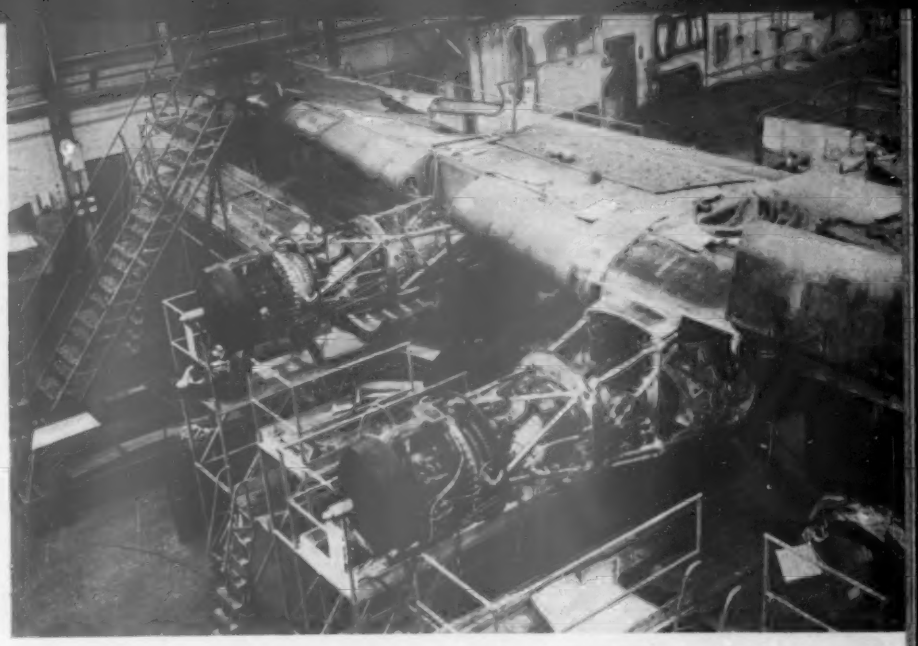
was already available within the Hawker Siddeley group of companies—that of the Avro Shackleton.

This must not be taken to imply that the Shackleton wing has been adopted *in toto*. In fact, the basic size and shape are the



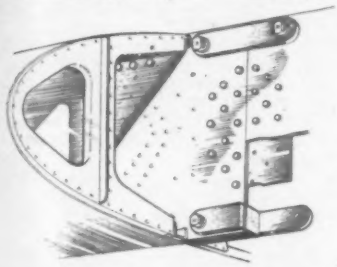
SUBSONIC BOOMS.—Ease of rear-loading without excessive drag penalties decreed a twin-boom layout for the Argosy.



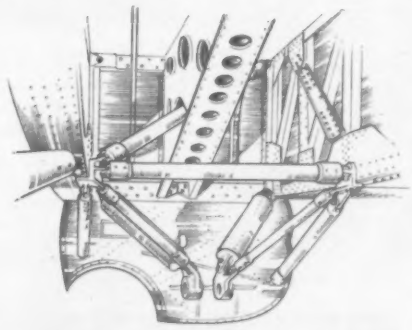
WILLING HORSES.—Four Rolls-Royce Dart R.Da.7/2 Mk. 526 turboprop engines each provide 2,100 e.h.p. at take-off, fitted with Rotol propellers.

principal legacy from the Avro design, and the Argosy wing has been manufactured from an almost completely fresh set of drawings.

Main wing structure is in five sections (centre-section, outer planes and tips). It is of two-spar type with 10 bag-type fuel tanks between the spars. Tank bays are formed by main ribs



Intermediate wing—outer wing joint at the front spar.



Structure inside a main undercarriage bay.

which have channel-section booms and N-braced webs. Other ribs are flanged pressings with webs cut-away for tanks.

Spar joints at the mating faces of the five sections of wing are by bolted shackle-links at the booms and bolted butt straps at the webs. Mainplane attachments to the fuselage are by two U-shaped frames, one each at front and rear spars, with side members of double-channel section. Each "leg" of these frames is attached to a spar member by a pin joint and a pin-jointed link. Provision is made for lubrication of these joints. A drag link joins an inter-spar main rib to a longeron on each side of the fuselage.

Apart from the region of the undercarriage bay and centre-section where there is no lower skin, wing skinning is continuous. Tail booms are attached by a light-alloy tubular structure picking up the two inboard engine-bay ribs. The four Dart engines are each mounted on a tubular structure stabilized by the firewall and gearbox mounting frames and picking up with strongly braced ribs.

Main units of the undercarriage are mounted on tubular structures which also pick up with the inboard engine-bay ribs. Leading-edge panels of the wing are hinged on the upper surface for access to control and pipe runs. Large detachable panels in the wing under-surface give access to the fuel tanks.

Semi-monocoque tail booms are of elliptical cross-section. The structure is of channel or I-section frames, Z-section stringers and flush-riveted light-alloy skin. Three U-shaped frames at the front end of each boom enclose the main undercarriage bays and a water-methanol tank for boost at take-off.

Attachment of each boom to the wing centre section is at four longeron pick-ups, the longerons extending beyond the undercarriage bay to the forward hoop frames.

The one-piece two-spar tailplane is of fail-safe design, all structural elements having duplicated load paths. Each spar has four angle-section booms and webs of laminated Redux-bonded sheet. Completing the torsion box are top and bottom skin panels with Redux-bonded spanwise stiffening stringers.

The tailplane is pin-jointed to the tail booms through four attachment forks, two at each end and on the spar extremities, which mate with lugs at double frames on the tail booms. As with the mainplane, the leading edge is detachable for access to control runs.

Each fin consists of a front spar, stub rear spar, chordwise ribs and light-alloy skin. Again, the leading edge is detachable for internal access. Attachment to each tail boom is by three pin joints, two at the base of the front spar and a third at the base of the rear spar.

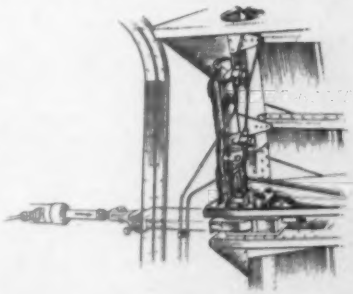
Fuselage Design

In many ways, the fuselage of a freight-carrying aeroplane is analogous to the hull of a ship. It must provide a maximum amount of usable volume and must be capable of loading with reasonable convenience.

The Argosy has a large and simple fuselage consisting of a freight hold surmounted at the front by a flight deck. A big feature of the design is the provision of side-hinged loading doors at front and rear of the freight hold.

The open-ended fuselage is a semi-monocoque structure of light-alloy frames and Z-section stringers. Multiple load-path design requires that all frames be attached to the skin. The stringers are built in as intercostals with boom continuity through the frames, finger straps and an inter-boom channel.

Most frames are built-up into an I-section above floor level with a channel-section under it. The open ends of the fuselage

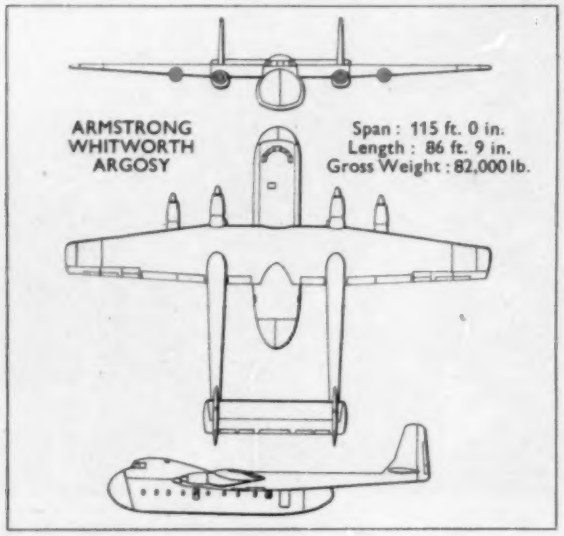


Typical freight door lock mechanism for the Argosy.

are formed by frames with large rectangular holes forming loading entry to the hold.

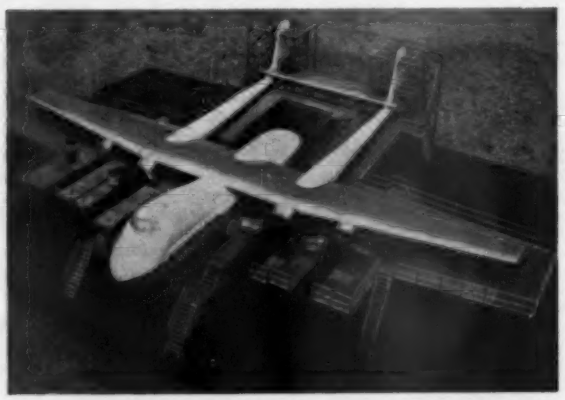
Low stress-levels in the fuselage from both pressurization and dynamic loads are maintained by use of Redux-bonded doubler plates around cut-outs and stress concentrations.

At the wing and nosewheel bay cut-outs, the fuselage is



reinforced by stainless-steel longerons. The nosewheel is mounted on steel underfloor beams which are fixed to strong frames with extruded angle-section booms. Similar booms are used on the two spar frames. Where two slices are cut into the top fuselage for the wing spars, the pressure bulkheads are reinforced by corrugations or top-hat-section stringers.

Six longitudinal rails at 20-in. pitch are built into the freight floor with lashing slots at 2-in. pitch. These slots can also take fixings for passenger seats. The flight deck floor is mounted on transverse I-section beams pin-jointed to the main frames, the floor skin being flush-riveted to the beams. Except for the nosewheel bay, the entire fuselage is pressurized.



IN THE DOCK.—This model is of a maintenance dock designed for the Argosy by Rodger, Setterington and Partners of Ealing.

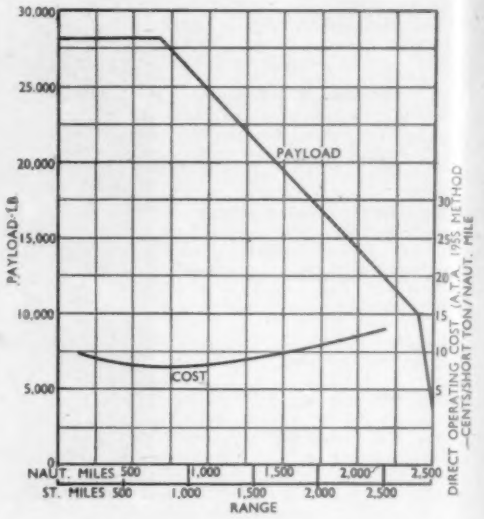
Freight doors forming nose and tail of the fuselage are of light construction containing bonded honeycomb-core panels for stiffening. A pressure bulkhead is built into the front door so that, if desired, an unpressurized radome can be mounted in the extreme nose. Both doors are side-hinged. They are operated by a manually or electrically operated nut and lead-screw device, the latter method being the production standard. Door locking is hydraulic by a multi-jack system giving even pressure around the door.

Seats for the pilots and other crew members are by Rumbold, and the lightweight folding seats for passengers are by Transport Seating of Birmingham.

Performance and Prospects

First wind-tunnel test of an A.W.650 model was in October, 1956. About 2,000 tests have been made of the A.W.650 and its variants, representing about 1,000 hr. of tunnel running at Armstrong Whitworth alone. In addition, about 75 hr. of testing has been done by A. V. Roe with a 1/30 scale model built by A.W.A. and a 1/10 scale half-model made by Avro.

Drag tests at the N.P.L. have been made in the compressed air tunnel at a pressure of 25 atmospheres, using a 1/12 scale



PROVISIONAL PERFORMANCE.—Payload/range potential and direct operating cost are shown in this graph of estimated performance for the Argosy.

model. This was followed by tests on a special 1/30 scale model of the A.W.670. Ditching trials have been completed by Saunders-Roe.

Present estimates indicate that the Argosy will be able to take a maximum no-reserves payload of 28,000 lb. over 600 nautical miles, the payload limitation being that of zero fuel weight. With a 20,000-lb. payload the no-reserves range is 1,400 miles and with a 10,000-lb. payload the range is nearly 2,400 miles. Allowances are made for 630 lb. of fuel for starting, take-off, circuits, landing and taxi-ing; for 330 lb. crew, and a 5% tolerance on fuel carried. With reserve fuel for 45-min. holding at 5,000 ft. on all engines, followed by a 200-mile diversion from 1,000 ft., the range with a 10,000 lb. payload is about 2,000 nautical miles.

With a take-off weight of 82,000 lb., the balanced field length needed is just over 4,000 ft. in I.S.A. sea-level conditions. Loss of power at high ambient temperatures is restored by use of water-methanol injection.

The first 10 aircraft should fly before the end of next year with deliveries beginning in 1960. Several overseas letters of intent have been received for the A.W.650 and there are also good prospects from nearer home. The military A.W.660 also promises well in sales potential, and the unpressurized short-haul A.W.670 has aroused great interest.

For many years A.W.A. has enjoyed an enviable reputation for production speed and quality. It is appropriate that as times become difficult for the aircraft industry the company is working all-out on an aeroplane of its own design, backed by the resources of Hawker Siddeley. Moreover, the aeroplane concerned is one which should do well in World markets where an up-to-date aircraft of this type is badly needed.—D.G.

DOUBLE DECKER.—The A.W.670 unpressurized Air Ferry is shown in model form. Up to 30 passengers are accommodated above six motorcars. The Airbus all-passenger version can seat up to 126 on short-haul services.

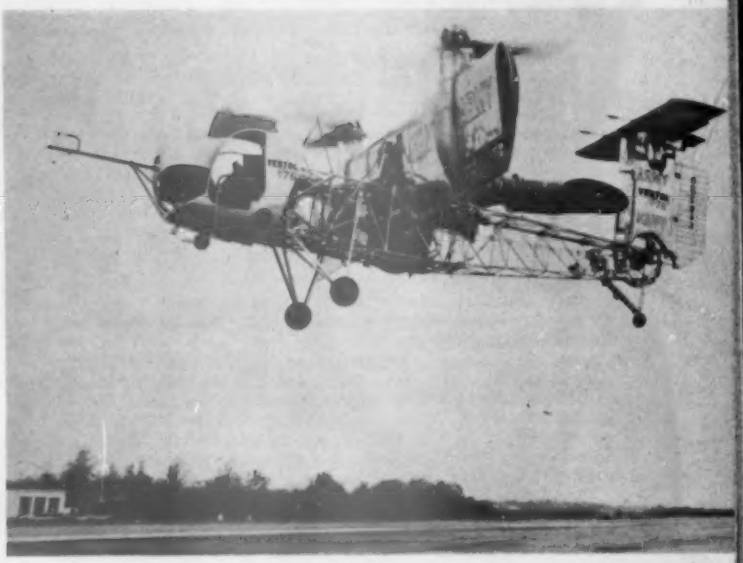
Right, the Vertol 76 tilt-wing aircraft making an STOL take-off with the wing at 55°; it was being demonstrated on October 21 at a joint meeting of the U.S. Army Association, the American Helicopter Society and the Institute of the Aeronautical Sciences.

Below, hovering with the wing at 82°.

Below, since the Vertol 76 was last seen in public there have been some minor modifications to its rudder and tail wheel unit. The vertical tail rotor duct has been increased in thickness to 3 in.

New World Photo-News

Pictures from Howard Levy



Above, another shot of the aircraft hovering; to date, about 20 transitions from hovering to forward flight and back have been accomplished.

Below, the Vertol 76 with its wings in the normal flying attitude; note the nosewheel that has now been added.

Flying the Linnet

By John Fricker

ONE OF the most popular, as well as the most attractive, French light aeroplane designs recently produced for amateur or professional construction is the graceful little Piel Emeraude, of which about 60 are already flying on the Continent. These have mostly been built by several small aircraft companies, since the compound curvature of the Emeraude's lines present a tricky constructional proposition for the unskilled amateur.

Two years or so ago the Garland-Bianchi Aircraft Co. was formed in this country to build the CP-301 Emeraude, and construction of the first machine, renamed the Linnet, began in January, 1956. The completed Linnet made its first flight on September 1 this year at Fair Oaks, in the hands of Sqn. Ldr. Neville Duke, who has undertaken all the development test flying for the award of a British C. of A.

Initial flights were done with the power of the 90-b.h.p. Continental gated to a maximum of 75 b.h.p., so that the Linnet could be operated under a Popular Flying Association Permit-to-Fly, but it has since qualified for a restricted A.R.B. C. of A. and is to continue for a " private category " clearance.

In general, the Garland-Bianchi company has kept fairly close to the original Emeraude design for a two-seat all-wood low-wing touring monoplane, and the Linnet differs only in equipment and certain modifications to bring it into line with British practice. The slab-sided silver spruce fuselage has a top decking built up from multiple stringers and is fabric-covered, while the forward part is stiffened internally with ply which forms the walls of the cockpit. The main planes are built up on a single spruce and ply box spar, with a plywood leading-edge to form a torsion box.

Slotted ailerons and flaps are attached to a hinge rail connecting to the rear pick-up point of the wings, which are of very robust structure. The large cockpit canopy incorporates a steel-tube overturn arch, and the two forward-hinged doors have steel frames (except in the prototype Linnet, where wood was used). Entry into the cockpit via the wing walkways and these doors is not difficult and, although the aircraft is scaled down almost to ultra-light size, accommodation is truly commodious. All-round view is also exceptional.

The side-by-side seats have provision for dual control, although the starboard stick was not fitted to G-APNS at the time of our recent flight at White Waltham, and a central plunger-type throttle is shared by both occupants. In production Linnets this will be augmented by another throttle on the left-hand cockpit wall. The short and straight control column is located rather close to the front of the seat, but is as comfortable as a sports-car gear lever to use. Not being very long in the leg, however, I found the rudder pedals only just within acceptable reach.

Close-set heel brakes are provided for the left-hand occupant, and in the Linnet are cable-operated, since the Emeraude's hydraulic type are not available in this country. Taxi-ing on soggy grass and flying in virtually zero-wind conditions, I had no occasion to use the brakes at all, but they apparently have no tendency to raise the tail when coarsely applied.

The Linnet has a comprehensively equipped cockpit, including Ekco 2-channel VHF radio, and a full blind-flying panel is centrally located for use by both occupants. Below this panel and flanking the throttle are knobs for cabin heat, carburetter air and mixture controls, while engine instruments, and starter and primer knobs are on the left of the dash.

Main fuel is carried under the front fuselage coaming in an 18-gal. tank, which in itself gives a flight endurance of about 4 hr., but the prototype Linnet has an auxiliary tank of 10-gal. capacity behind the seats to give an additional 2-3-hr range. With this tankage, the south of France, for example, comes within non-stop cruising range of the Linnet, with two occupants, but the single forward tank is adequate for normal operations. The rear tank will therefore only be fitted to order.

The car-type starter on the Continental swings it infallibly into life on the internal power of the Varley battery, the dashboard primer ensuring that all starting operations can be conducted from the cockpit. All the vital instruments and controls are labelled with their limit figures, and when the oil temperature reaches 23° C. the Linnet is ready for a power check and take-off.

Noise level is moderate, although Doug Bianchi is seeking to reduce it still further, and the Continental, like all these superlative American engines, responds smoothly to throttle application. The Linnet sits very firmly on the ground on its wide-track undercarriage, which gives a comfortable and well-damped ride on its rubber-in-compression legs, although there is a little oscillation at the moment from the leaf-sprung tailwheel.

This could well be made steerable on production aircraft, to simplify taxi-ing and operation in strong winds, but ground manœuvrability is otherwise good. Another slight shortcoming on G-APNS is the absence of a parking brake, but this is to be rectified on later Linnets.

For take-off, the sizeable and sensitive trim lever between the seats controlling two large tabs on the elevators is selected to neutral, and flap lowered by the adjacent lever to the first position if required. There is a direct manual linkage to the

flaps, which can be extended to 15° or 50°, with a correspondingly large range of movement of the lever, with its sliding handle release. Flap-lever movement is unusual in being linked with the elevator tabs, so that trim changes are automatically cancelled.

Opening up to 2,475 r.p.m. for take-off necessitates a fair amount of starboard rudder to counteract a swing to port, but the rudder becomes effective very quickly, and the Linnet unsticks at about 40 knots I.A.S. As the ground angle is small, it is hardly necessary to raise the tail, and the Linnet climbs away with continued right rudder at about 60-70 knots after a very short ground run.

Solo, the initial climb seemed to be approaching 700 ft./min., although an unsuitable airscrew prevented a truly representative performance from being obtained. On raising the flaps there was little or no sink, although the interconnected trim induced a slight pitch if the lever was moved quickly.

The resemblance of the Emeraude to a miniature Spitfire has been widely commented upon, and on flying the Linnet it quickly becomes apparent that the similarity extends to handling. An ideal compromise has been achieved between sensitivity of control and an excessively "ultra-light" response, so that a relatively firm application of stick or rudder results in a crisp and effective reaction. Control harmonization is particularly good, and although the rudder is perhaps slightly heavier than elevators or ailerons, its use is unnecessary in most manœuvres.

Rudder effectiveness at small angles is possibly decreased by the rather thick section of its leading edge and the fin junction, which results in a noticeable increase in control force at large deflections. It may also account for the slight difficulty in countering a directional out-of-trim force which requires a small amount of right rudder in G-APNS until power is reduced. This, however, is almost certainly a peculiarity of the prototype.

Apart from this the Linnet has no trim change of any magnitude above two or three pounds' stick force, and from the climb, inching the trim lever forward a fraction will suffice for cruising flight. At 2,350 r.p.m. (76.5 b.h.p.) the speed settles down to 100 knots (115 m.p.h.), which is a very commendable figure for so tiny an aeroplane, and gives an economical a.m.p.g. of more than 25.

At all airspeeds the ailerons of the Linnet are particularly delightful, and a small stick displacement winds one up very rapidly into a steep turn. Neville Duke has measured the rate of roll when cruising at about 70°/sec., which is almost up to early jet-fighter standard, and the elevator control force averages a similarly pleasant 10 lb. or so per *g*.

Control response remains good throughout the speed range, and in the power-off clean stall, the wings can be kept level by coarse use of aileron as the aircraft nods gently along in and out of the stall, at about 35 knots I.A.S. (P.E.C. is about +8 knots at this point). I found in tests at about 2,500 ft. that this behaviour continued even with the stick held back after the slight preliminary vibration, and there was no positive stall breakaway.

With full flap, however, and partial power, the Linnet sat up and begged for a while until, at about 30 knots I.A.S., the nose and the port wing dropped gently with virtually no warning. Recovery was immediate on pushing forward the stick, and this is apparently also the case with spins. These have been done at forward C.G.s by Neville Duke from about 10,000 ft., and are clean and fast with positive recovery immediately on applying slight opposite rudder.

As the Linnet is so clean aerodynamically, acceleration is rapid in the resultant steep dive, but from entry to complete recovery from a two-turn spin occupied only 1,000 ft. Neville Duke has also explored other performance extremes, including diving to 130 knots (150 m.p.h.), climbing to 11,500 ft., and flying at extended aft C.G. range.

For landing, full flap can be lowered below 70 knots, and the interconnected trim results in a "hands-off" approach speed of about 60-65 knots, with a little power. The optimum speed is actually about 50 knots, so that there is a slight out-of-trim force, which cannot be cancelled as the trim lever is overridden after full flap has been selected.

The slotted flaps are very powerful, and the rate of sink when they are fully deflected is high. For a power-off glide, 60 knots is needed to give a brief float, with a large change of attitude, but motoring the Linnet in at about 50 knots requires only a gentle flare-out for a smooth touch-down. Except when landing in very restricted areas, the take-off setting should be ample, although overshooting with full flap presents no problems at all.

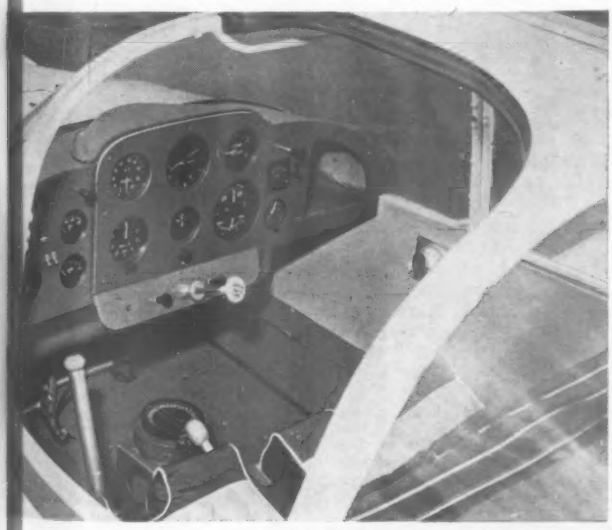
To sum up then, the Linnet handles like a thoroughbred, and offers excellent cruising performance, capacity, comfort and economy for touring. It also seems rugged enough for training, and is the first really new light cabin-aircraft to be produced in this country for a very long time. The second Linnet is already half completed in the Garland-Bianchi factory at Maidenhead, and production of further aircraft is contemplated at the competitive price of about £2,200.

Technical Data

DIMENSIONS.—Span, 26 ft. 4 in.; length, 20 ft. 9 in.; wing area, 117 sq. ft.

WEIGHTS.—Empty, 802 lb.; fuel, 129 lb.; oil, 9 lb.; crew, 340 lb.; disposable load, 120 lb.; max. gross, 1,400 lb.

PERFORMANCE.—Max. speed, 130 m.p.h.; cruising speed, 115 m.p.h.; take-off run, 200 yd.; landing run, 175 yd.; ceiling, 11,500 ft.; max. range, more than 700 miles.



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CLEAN COCKPIT.—Neat and tidy in layout, the Linnet cockpit is comprehensively equipped with a full blind-flying panel and electrical equipment.

LINNET AIRBORNE.—The beautifully clean lines of the Linnet are revealed as Neville Duke lifts it off the ground at Fair Oaks with the aid of take-off flap.

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Farming by Helicopter

Photograph copyright "The Aeroplane"

CROP-SPRAYING by helicopter is a well-established agricultural practice. The latest type of helicopter for this work to be demonstrated in England is the Kolibrie H-3 built by the Netherlands Helicopter Industry N.V., of Rotterdam.

Functional simplicity is necessary for anything used for farming purposes and the Kolibrie layout meets this requirement. Ramjet-power for the two-bladed main rotor removes the need for torque-reaction, gearbox or clutch. The single-bladed tail rotor is for directional control only.

The two blades of the main rotor are connected by a sheaf of leaf springs which replace more conventional torsion bearings and flapping hinges. A rigid tube between the blade roots acts as a droop stop and is a hinge-line for blade incidence. The blades are of Redux-bonded construction, made by Fokker.

As shown by a demonstration at Ipswich on November 10 (THE AEROPLANE, November 14), the Kolibrie is remarkably stable and rapidly manœuvrable. Stability is a function of the patented self-adjusting rocking-type rotor system. This is designed so that the blade centre of gravity is ahead of the centre of pressure, increasing air loads thus tending to decrease the angle of incidence and reduce disturbances. The chief test pilot of N.H.I., Rene van der Harten, showed the "hands-off" hovering qualities at a height of a few feet.

Noise-level of a ramjet is high, and the humming bird from Rotterdam has a raucous Doppler-effect "chugging" song at close quarters while running-up. Once on the move, the noise-level drops rapidly and can be no worse than the exhaust of a large tractor. A short flight in the Kolibrie showed us that the pilot was little affected by the ramjet's roar.

Operating from a trailer platform, the Kolibrie made spraying runs at less than a yard above the ground, using a quickly detachable spray bar 65 ft. wide.

Two small two-stroke engines were fitted to the helicopter, one for spinning the rotor up to ramjet lighting speed (100 r.p.m.) before cutting out (130 r.p.m.) and the other for pumping spraying fluid to the spray bar. The starter engine can be deleted and replaced by a flexible drive from a ground power unit.

Operating speed of the rotor is 400 r.p.m., and this gives a useful store of kinetic energy in addition to the twin-engined safety provided. The pilot demonstrated single-engine flying and then cut both engines, came down in an accelerated autorotation and climbed vertically with both engines dead.

The Kolibrie seats two and has dual control, although one seat can be removed to increase payload and endurance. With pilot only, the endurance is 1 hr. at up to 45 knots. Gross weight is 1,434 lb. comprising an empty weight of 530 lb. and 904 lb. for pilot, fuel, equipment and payload. A total of 75 acres of crops can be sprayed in an hour at a cost of 35s./acre, plus chemicals.

As noted in our previous issue, the Kolibrie costs £8,050, or £13,500 complete with full agricultural equipment and operating trailer vehicle. European Helicopters, Ltd., of Ipswich Airport, Suffolk, has the United Kingdom import and distribution rights for the Kolibrie.

Ten production Kolibries have been completed and nine have been sold. A second batch of 10 is now under way. Having seen the Kolibrie demonstrated, and travelled in it as a passenger, the impression is that it is a highly practical and rugged little aircraft well suited for agricultural purposes. Its special merits are twin-engined safety, lack of an *anti-torque* rotor (damage to which causes about half of all helicopter accidents), simplicity and the safety given by the high amount of kinetic energy stored in the rotor. This last feature gives about 10 sec. to achieve autorotation if both power units fail, compared with about 1 sec. for piston-engined types.—D.G.

Mr. Povey Retires

AFTER 44 years in the aircraft industry, Mr. Harry Povey, F.R.Ae.S., is to retire from the board of the de Havilland Aircraft Co., Ltd., on November 30.

Born in 1890, he served his apprenticeship with Bellis and Morcom, of Birmingham, and later went to the Wolseley car design office. When the First World War began in 1914, Mr. Povey joined the Royal Aircraft Factory (now the R.A.E.) at Farnborough as a draughtsman, and later became an assistant designer. His first association with de Havilland came about in 1917 when he was appointed works manager of May, Harden and May, Ltd., which was building some F.2A flying-boats designed by the Aircraft Manufacturing Co.

For a time thereafter he worked with Mr. H. P. Folland at the British Nieuport Co., but in 1924 returned to de Havillands. He was appointed chief inspector of aircraft two years later, and was then made responsible in a similar capacity for D.H. engines. In fact he introduced the engine-inspection organization for Gipsy engines from the beginning right up to the Gipsy Six, certifying more than 6,000 production engines.

After a visit to the U.S.A. in 1934-35 to study production and inspection methods of the Hamilton propellers, he established a new propeller-manufacturing technique at Stag Lane. So for many years he carried the responsibility for aircraft, engines and propellers.

In 1938 he became production manager at Hatfield, at a time when the company began building all-metal aircraft such as the Flamingo, but his name is perhaps more generally associated with Mosquito production, concerning which his outstanding administrative ability was shown. Later he was responsible for setting up Mosquito production in Canada.

Returning to England in 1944 as chief inspector (aircraft), he became general production manager a year later. Since the War he has been mostly concerned with Comet production, and the vast number of tooling and fabrication techniques which

(*Continued on page* 763)

(*Continued from page* 762)

it involved. During this period he also found time to get the Chester factory producing Comets, Doves, Herons, Vampires, Venoms and Chipmunks—some 3,750 aircraft in 10 years.

It was in 1951 that Harry Povey was elected to the board of the aircraft company, and soon began reorganizing the Portsmouth and Christchurch factories of the Airspeed company, which were then becoming fully integrated with de Havillands.

Two years ago he began applying his abilities to the problems of LRBM production, where his extensive experience has proved of superlative value.

Since 1946 he has served on the S.B.A.C.'s standing committee on production; he received the R.Ae.S.'s bronze medal in 1952 in recognition of his work on the Comet, and played a leading part in the formation of the de Havilland (Aircraft) Engineering Society.

Mr. Povey will be a difficult member of the de Havilland Enterprise to replace, for his contribution to the organization, and to the world of aircraft production generally, has been immense. In acknowledging the respect which all hold for him, and the influence he has had on the industry, we extend our sincere good wishes to him in his retirement.

Is Man-powered Flight Possible?

NOT for the first time Mr. B. S. Shenstone, F.R.Ae.S., has discussed publicly the possibility of achieving man-powered flight. On November 13 he chose the subject for the fourth Henson and Stringfellow Memorial Lecture given to the R.Ae.S. at Yeovil. We cannot give the paper in full; that must be obtained from the headquarters of the R.Ae.S. at 4 Hamilton Place, London, W.1. Here, however, we present some of the author's findings.

The tone of his approach may be gathered from the concluding words of his paper: "A failure on the first serious attempt to build and fly a man-powered aircraft would leave widespread doubts in the minds of people as to its ultimate practicability. Therefore, if success is to be achieved, the problem must be approached in a sound technical manner and taken as seriously as the design of any powered aircraft."

Man-powered flight has already nearly been done, and when something has practically been done it usually takes only a moderate addition of ingenuity and knowledge to make it properly done. It is not generally known that in 1936 in Germany a single-seat man-powered aircraft made at least four flights over 200 yards in length at an altitude between 3 ft. and 15 ft., and that these flights were officially observed. Each of the flights lasted about 20 seconds. Indeed, there was one flight which achieved a distance of 440 yards.

The German Haessler-Villinger aircraft of 1936 failed mainly because the power transmission was not efficient, it being transmitted from bicycle-type pedals through a belt to a propeller shaft on which was a small propeller well below the optimum size (under 5 ft.). It also failed because knowledge of aerodynamics at that time was not sufficiently advanced. It also failed because the optimum power was not available. In other words, the optimum number of crew is not one, but is considerably more than one.

A two-seat, man-powered aircraft has rather more than twice the power available, because in a single-seater it is probably impracticable to use more than the leg power of a man for locomotion, as he will need his hands to guide and control the aircraft. In the case of a crew of two, the second man can exert all his energy, arms and legs, for driving the aircraft.

An estimate of the power required to drive the Haessler-Villinger is 0.82 h.p., which can only be exerted by a man for a very short period, which is certainly less than a minute. It would be necessary to redesign this aircraft so that it used only about 0.6 h.p. A man cannot produce his full power through his legs alone and arm-power is significant.

A recent paper by Nonweiler in the October *Journal of the Royal Aeronautical Society* shows how the problem can be approached by a particular design solution and the assumptions involved are clearly stated, so Nonweiler's approach is the approach from scratch and is, of course, the approach that would have to be used by any practical designer or investigator. He starts out by showing what the limitations of the power available are.

Using arms and legs a man has an instantaneous power of something of the order of 1.5 h.p., but for a minute's duration he can exert about 0.8 h.p. only. However, for longer periods up to the time of the order of one hour he can exert 0.5 h.p. We can therefore use these powers with reasonable assurance, but with full realization that if calculations are wrong or the usual things occur, such as the actual aircraft having more drag and weight than the design, the only way to get over it is to find a stronger man, and there isn't much scope in that.

As a result of these figures, we can draw the usual power-required/power-available curves for flights of any reasonable duration. The aircraft then must be designed to fit one of these curves or it will be a failure.

Discussing such curves in which the actual power output of man or men is reduced by the inefficiency of propeller and drive, e.g., 80% propeller efficiency and 90% drive efficiency, giving an overall efficiency of 72%, the author admits that the last figure is conservative, but it is best at this stage to be careful. The results, however, are disappointing because even the two-seater does not fly very well. On the other hand, the weight has been almost doubled, the power available more than doubled, with a power-required increase of only about 30%. This is the right direction and it would not take much more ingenuity to bring success. Just slightly better assumptions would show that reasonably continuous flight is possible.

Information on actual weights of single-seaters in the past indicates that an empty weight for a single-seater can be as small as about 80 lb. Nonweiler's assumed empty weight for a two-seater is 170 lb., which is certainly not optimistic.

The machine should be made of wood and fabric. It is easy enough to design the spar, but that is not where the weight goes. The weight disappears into the ribs and frames, secondary structures and fittings, and very careful calculations would have to be made, including reproduction of complete test sections, to ensure not only that the strength was of the right order, but that the weight was acceptable.

The wing-section problem was until recently extremely difficult, but there is now some information available at the requisite Reynolds Numbers which are of the order 0.7×10^6. It is clear that what one wants to have is a wing section which has as much laminar flow as possible at this Reynolds Number and has the bottom of the laminar-flow bucket at a lift coefficient of the order of 0.9. At least two sections give some promise on this: NACA 65A(10)12 and the German Section FXO5-H-126.

The wing-section thickness which is practical on such an aircraft may be difficult to determine. Informal discussion with the Air Registration Board indicates that an ultimate load factor of not more than 2.5 will be acceptable with very little gust loading. This would mean that the wing would be very flexible and the detail design would have to be directed toward permitting it to be as flexible as possible, thereby saving weight and still avoiding flutter on control reversal at operating speeds.

Perhaps the most difficult problem is that of the propeller and the drive for it. Probably the most efficient sort of drive would be an adaptation of bicycle practice, that is, pedals, sprockets and chains.

Normal propeller construction would be too heavy. Possibly a propeller made entirely of balsa wood would be sufficient.

Adopting the flapping wing is adopting an extremely complex mechanism which suffers severely from structural scale effect and whose aerodynamics are not fully understood. The use of a flapping wing is the hard way towards the solution of man-powered flight. Flapping should not be the first method to be tried in an attempt to achieve man-powered flight, because then you are attempting to solve two distinct problems at one time. First, you are trying to make the flapping work, which has not yet been done on this sort of scale and, secondly, you are trying to accomplish man-powered flight, which has also not been achieved.

Both the Man-powered Aircraft Committee and Nonweiler suggest that an effort should be made to design the man-powered aircraft so that it can take off under its own power. This involves the use of wheel traction during the initial phases of the take-off because the propeller is very inefficient under these conditions. It would mean a gradual transfer of power from the driving wheels to the propeller near the unstick point. The danger here is that a crew may become so exhausted during the take-off run that although they are able to take off they are unable to keep the aircraft flying.

At present there is no likelihood of the man-powered aircraft rising more than a few feet above the ground because the power required within the ground cushion is so much less than the power required at about 15 ft. or 20 ft. In fact, at about 10-ft. altitude the ground effect doubles the effective aspect ratio of the wing, which has a large effect on the power required because the wing incidence is quite high. Hence the possibility of man-powered flight in the initial stages would be over flat fields, such as an airfield or over a small piece of water.

Round South America by Jet Provost

R. N. RUMBELOW *tells the story of a demonstration tour of South America with a Hunting Jet Provost 2 trainer (Armstrong Siddeley Viper turbojet).*

THE Jet Provost was crated and shipped to Trinidad, arriving on April 5. Mr. S. Ashby, Hunting Aircraft service engineer, started to assemble it on the 9th and Mr. F. Ashley, of Armstrong Siddeley Motors, and I arrived the day after. Improvisation was often necessary on a tour of this kind when normal servicing equipment was not readily available.

The aircraft was completed on April 20, and flew the next day. Subsequently we did a full-load take-off and navigation trip with ground temperatures at 96.3° F. We were airborne in 545 yd. with a 12-15-knot headwind and over 7,000 lb. all up. Practical figures closely approximated to the theoretical ones.

To Venezuela . . .

On April 28 David Bay (deputy sales manager) and Bill Kingwill (services liaison officer), with Ashby, set off by civil airline for Carácás, Venezuela. Ashley and I followed in the Jet Provost.

The forecast in Trinidad was good, one of the very few I was able to obtain, and we flew above 4 to 6/8ths cumulus along the north coast to Maiquetia, Carácás, at 25,000 ft. Once again I was able to check my consumptions, etc., during the 1 hr. 55 min. trip and everything worked out very well. All the long legs were done at 25,000 ft. with a T.A.S. of approximately 215 knots.

We stayed in Carácás for a couple of days and then moved down to Marracay for a week. Here six selected officers evaluated the aeroplane. Some staff officers were also flown and expressed their admiration of the aircraft's versatility. The Venezuelan Air Force have British equipment in the form of Vampires, Venoms and Canberras while their main training is at present done on the T-6 and T-11.

. . . And Colombia

On May 8 we left for Colombia, encountering much the same weather. All flight planning had to be done for nil-wind conditions. We were delayed at Maracaibo, our first stop, as we had to fetch oxygen up from the town. I was able to check on the weather at Barranquilla from a Pan American captain who politely told me the weather was always the same at Barranquilla.

We had intended to night-stop at Barranquilla, but, as the weather looked so good down south, we decided to press on if this proved to be so. For the rest of the tour we found airfields and weather stations connected by HF R/T and weather reports are sent out about every hour. Local aviators were all most helpful and advised me not to route through Medellin as it was a difficult airfield, even in relatively good weather, so it was arranged that I could land at the Air Force Base at Palanquero to refuel.

As expected, the weather en route was good, about 4/8ths cumulus, so we set off as soon as possible. All the way down to Palanquero we flew over inhospitable thick, matted jungle broken occasionally by rivers, and now and then we came across a clearing with a small airstrip in the middle. Over Palanquero it was quite obvious that we had enough fuel to get to Bogota, and back again if required, so we went on and were soon letting down at Bogota. This was the longest leg, some 410 nautical miles and over 2-hr. flying time.

Bogota, in the Andes, is about 8,500 ft. high and very dry. Unfortunately, the radio decided to quit and we had to send for a replacement from home. This was our only maintenance delay and put a week on the programme. We flew two or three officers at Bogota.

On May 20 we flew to the training base at Cali, where they use the T-34 Mentor and T-6 for training. Because of a high overcast which kept temperatures down we completed the programme in one day, and everyone expressed great enthusiasm for the aircraft. Later we saw something of the town and had the next day clear to have our first good inspection of the aircraft.

On to Ecuador . . .

On May 23 we left for Quito, along the Andes. Quito is at about 9,500 ft., surrounded by hills—no bad-weather approaches are made here at all. A large number of officers were flown here, some from the Meteor and Canberra squadrons, and some from the training base at Salinas, where they use the PT-19 Cornell and T-6. Once again the Jet Provost was very well received.

. . . And then to Peru

We left Quito on the 29th. The cloud was low and we didn't break out on top till 20,000 ft. Overhead Guayaquil everything was going according to plan, so we overflew and went on to Talara in Peru. At Talara the Peruvians sent up a couple of Hunters to escort us in.

We set off later for Trujillo to make Lima by day, flying over some 2/8ths stratus. The Humboldt current is in operation from about April to September and covers Lima in a layer of stratus anywhere up to 1,000 ft., which does occasionally break up.

On this occasion through the R/T we found that Lima was in fact clear of cloud. Over Chiclayo we advised our flight plan and just before letting down at Trujillo we called up for fuel to be available immediately on landing. The reply was "No jet fuel at Trujillo," so we pointed out that this had been arranged many months ago and there should be jet kerosene there. Again came the reply, "Definitely no jet kerosene at Trujillo," so we turned back to Chiclayo, where Canberras are operated.

We managed to persuade the Peruvian Air Force to let us have fuel. Late, we pressed on to Lima and about 15 min. before we arrived darkness fell, but the cloud remained broken and we made a VFR descent and night landing at Limatambo.

An Impressive Experiment

Here, where they use the Stearman and T-6, we were requested to train five students to solo standard, two with 40-50 hr. on Stearmans and three who had never flown. We agreed to undertake this formidable task and because of the weather we moved back to Chiclayo for the fortnight we took to complete the experiment.

The side-by-side seating of the Jet Provost enormously lessened the language difficulty. The Peruvian Air Force offered me the assistance of Capt. Hernandez, an experienced Hunter pilot with instructor's qualifications, who speaks good English. He had no experience of *ab initio* instruction and I had to prepare

The Jet Provost, G-AOHD, is here seen at the Colombian Air Force training school, Cali.

a detailed schedule from memory and give him an intensive period (5 hr. dual and solo) on the aircraft. Fortunately, pilot's notes in Spanish were available.

I undertook the training of the two part-trained cadets, while Hernandez instructed the others, all, of course, under my supervision. The cadets were extremely youthful; the youngest was 16, and he in fact proved to be the most apt.

The whole experiment was extremely successful. It showed that in spite of the difficulties involved and the youth of the students (who were selected at random) it was possible with a complete absence of normal facilities to reach solo standard within 2 hr. of the R.A.F. average.

The times to reach solo standard were:—

Part-trained cadets, 8 hr. and 5 hr. 40 min.; *ab initio* cadets, 9 hr. 5 min., 13 hr. 45 min. and 13 hr. 45 min.

We returned to Lima on June 22, first making a low-level hop to Trujillo. At Lima we flew a considerable number of staff officers and instructors.

In Chile

On June 28 we set forth for Santiago. The first leg was a low-level one to Pisco where we were delayed because the fuel had to be brought up from the town. The next leg was along the edge of the Andes to the "white town" of Arequipa, about 8,500 ft. We stayed the night here and set off for Arica early next morning. There we made our first ADF let-down of the tour, and after refuelling set off for Antofagasta where we again made a night stop.

The following morning, with 20° of drift to counteract the strong westerlies, down we went to Vallenar using the local broadcasting station as our beacon, and the final leg to Santiago was made over increasing cloud, which broke up on our arrival.

In Quito were Maj. Salorzano, author, Snr. Bucheli, Gen. Cabrera, D. Bay, F. H. Gamble (British Ambassador), Capt. Arias, Snr. Moreno (Minister of Defence), Gen. Ochoa (Chief of Ecuadorian Air Force) and Admiral Nieto.

At Chiclayo, Peru, pupils trained on the Jet Provost (front row, left to right): Melena, Bucala, Busse, Melgar and Arenas. Back row: S. Ashby, W. Kingwill, Maj. Alvistur, L. P. Navarro, author, Col. Gonzales (F.T.S. director), Capt. Hernandez and F. Ashley.

On July 2 we flew the total 10 officers designated—which was a record for the tour and one that completely exhausted me. Here they train on the T-34 and T-6, but judging by the enthusiasm they would have preferred the Jet Provost.

Demonstration in Argentina

The next day, without a cloud in the sky, we set off for Argentina and flew across the Andes by the north pass where the mountains stand at some 20,000 ft. with Aconcagua (23,034 ft.) on my left.

We landed at Mendoza, did a couple of demonstrations, and moved on next day to Cordoba. Here are situated the Aeronautical Institute and main training school (T-34 and Fiat G.46). Flights were given to pilots of both establishments.

We moved on to Buenos Aires on July 8 across fertile plains mostly covered by cloud, but this broke up just before we arrived at Moron Airport. The visit to the Air Force at Buenos Aires was impaired by weather, holidays and a number of political events. A week later we moved down to the naval school at Bahia Blanca, where we flew half a dozen pilots.

Uruguayan Interlude

We went back to Buenos Aires on the 17th, and two days later flew across to Montevideo.

Primary training there is done on the PT-19 and Chipmunks, followed by basic training on the T-6, and there are a few T-33s for conversion and advanced jet training. There is an urgent need for a new trainer and it was agreed that the Jet Provost would be just what the doctor ordered.

The End of the Tour

Rio de Janeiro was our next call, where we arrived on the 25th after flying over about 4/8ths coverage. Champing at the bit to complete the tour, we rushed off to Pelotas, our next stop. This was the only natural "dust and small stone" runway that we used on the whole tour though it was one of many on which we had the honour of being "the first jet to land."

General clearance at Pelotas, Porto Alegre and Curitiba was slow and uneventful, but we had refuelling trouble at Sao Paulo. In darkness and low visibility we finally got out of Sao Paulo a few minutes before fog closed the airfield for the night. An hour and a quarter later, after flying over Rio, we touched down at the international airport of Galleon.

We flew at Santa Cruz where they operate Meteor 8s; at Campos dos Afonsos, the training school, where a number of officers went solo, and at Santos Dumont with several staff officers. Once again G-AOHD met with much admiration. On August 2 a final display was given over the famous Copacabana Beach, which put a fairly fitting end to a long tour.

Some days later, after a few more trips, the aircraft was dismantled and crated for shipment back to the U.K. Whereas assembling the aircraft in Trinidad had taken us 10 days, here it took only two days to dismantle and crate up.

As for the aircraft, I think that speaks for itself. One instrument was replaced, two navigation light filaments, some rubber seals in the brakes, one flap interconnecting rod and two sets of main wheel tyres. The 50- and 100-hr. schedules were done in each case on a Sunday without interrupting the programme. A welding repair was made at Montevideo on the jet tail cone, and then of course there was the radio.

Throughout the tour my invaluable Marconi ADF never once let me down; it is the only navigation and approach aid in existence at the moment in South America. In addition, the little ASV.8 engine hummed away merrily behind me without an ounce of trouble.

One hundred and twenty three different people flew with me; 27 airfields in nine countries added up to some 8,400 miles of transit flying. With demonstrations thrown in the total flying time came to 178 hr. in 268 flights, with 630 landings recorded.

I think the final judgment came in Montevideo, when with some 430 airframe hours, the last 150 of which had been spent beating round South America, a U.S.A.F. major from the training mission came up to me and said "What a nice bran' new little ship you've got there!"

The Fighting Services

A Senior R.A.F. Promotion

AIR MARSHAL SIR THEODORE N. McEVOY, K.C.B., C.B.E., Chief of Staff, Allied Air Forces Central Europe, since May, 1956, has been promoted to the rank of Air Chief Marshal with effect from November 1. Before his present post he was R.A.F. Instructor at the Imperial Defence College.

Entering the Service through the R.A.F. College, Cranwell, where he won the Sword of Honour in 1923, his early flying was mainly with fighter squadrons, and during the 1939-45 War he was concerned with fighter operations. He formed the first Polish fighter Wing in 1941 and was S.A.S.O. of No. 11 Group in 1943. Between 1943 and 1945 he was S.A.S.O. of No. 84 (Fighter) Group.

Comet World Tour

AIR MARSHAL SIR ANDREW McKEE, K.C.B., C.B.E., D.S.O., D.F.C., A.F.C., A.O.C.-in-C., Transport Command, left R.A.F. Lyneham on November 10 on the first round-the-World flight to be attempted by a D.H. Comet 2 of No. 216 Squadron. The aircraft, which is flying westward, is routed across Canada and the United States, over the Pacific to Honolulu and Christmas Island, then on via New Zealand.

In Australia the Comet will visit Adelaide, Melbourne and Sydney before returning to the United Kingdom via Singapore and Hong Kong. It will be the first time that a Transport Command Comet has landed at Hong Kong. The aircraft is expected back at R.A.F. Lyneham on December 2; the planned flight time for the tour is 81 hr.

Marine Craft Cup

THE Marine Craft Unit Efficiency Cup for 1957-58 has been won for the first time by the Marine Craft Section of the R.A.F. Element (Flt. Lt. J. Vendrelle) at the Joint Anti-Submarine School at Londonderry, Northern Ireland, with the Marine Craft Section at R.A.F. North Front, Gibraltar, as runners-up. The Gibraltar unit won the cup in 1954-55, were runners-up in 1955-56, and winners again in 1956-57. All R.A.F. marine craft units in Coastal Command's No. 18 Group (Pitreavie, Scotland) and No. 19 Group (Mountbatten, Plymouth) and the unit at Gibraltar take part.

NATO Visit to Wyton

HEADED by the Secretary-General, M. Spaak, a party of NATO officials from 12 countries visited R.A.F. Wyton on November 10. Flying from Paris in a Transport Command Comet, the party was met at Wyton by the Secretary of State for Air, Mr. George Ward; the Under-Secretary of State, Mr. Charles I. Orr-Ewing; the Vice-Chief of the Air Staff, Air Marshal Sir Edmund Hudleston; the A.O.C.-in-C., Bomber Command, Air Chief Marshal Sir Harry Broadhurst, and the A.O.C., No. 3 Group, Air Vice-Marshal K. B. B. Cross.

During their tour of the station the visitors received a comprehensive briefing on the potential of Bomber Command as a deterrent force and the work of the R.A.F. Central Reconnaissance Establishment. In the hangars they saw all three V-bomber types—the Victor, Vulcan and Valiant—as well as the Lightning fighter.

Five Valiants of No. 543 Squadron staged a "scramble"; within 3 min. of the alarm they were taxi-ing on to the runway. The first was airborne in 4 min. 7 sec. and all in 6 min. 2 sec. A Lightning, piloted by Sqn. Ldr. James Dell, also made a high-speed fly-past and gave a demonstration of its handling qualities.

Senior Postings

AIR VICE-MARSHAL H. P. FRASER, C.B., C.B.E., A.F.C., at present A.O.C., No. 12 Group, Fighter Command, is to become Director of R.A.F. Exercise Planning with effect from January 1, 1959. Chief of Staff, Allied Air Forces Central Europe, before going to No. 12 Group in June, 1956, A.V.M. Fraser was previously S.A.S.O., Fighter Command.

Succeeding A.V.M. Fraser as A.O.C., No. 12 Group, is Air Cdre. J. R. A. Embling, C.B.E., D.S.O., who takes up the appointment with the acting rank of Air Vice-Marshal. At present attending the Imperial Defence College course, Air Cdre. Embling was previously Eastern Sector Commander, Fighter Command.

Air Cdre. H. H. Chapman, C.B., C.B.E., has been appointed Director-General of Technical Services at the Air Ministry with the acting rank of Air Vice-Marshal. From 1952 to 1953 Air Cdre. Chapman was Director of Signals (Policy) at Air Ministry, and was S.A.S.O., No. 90 (Signals) Group (now a Command), from January, 1955, to September of this year.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Group Captain A. R. C. Young, O.B.E., to the R.A.F. Hospital, Ely, as specialist in radiology.

Wing Commanders: C. H. Baker to No. 5 (Light Anti-Aircraft) Wing, R.A.F. Regiment, to command; N. Cameron, D.S.O., D.F.C., as Personal Staff Officer to the C.A.S.; I. J. De la Plain to R.A.F. Laarbruch, 2nd T.A.F., for technical duties; D. E. Gibbs, M.B.E., to No. 71 M.U., to command; H. Harvey, to the M.o.S.; F. J. Higham, O.B.E., D.F.C., to R.A.F. Waterbeach, to command the Administrative Wing.

Squadron Leader F. H. A. Campbell, M.B.E., to R.A.F. Weeton for administrative duties (with acting rank of Wg. Cdr.).

FIRST SEA VIXEN.—No. 700 "Y" Flight (Cdr. M. J. H. Petrie, R.N.), which is to undertake the Service trials of the D.H. Sea Vixen, was formed at Yeovilton on November 4. Its first aircraft — XJ 482 — was handed over to the C.O. (centre) by Mr. Jock Elliot, D.H. test pilot, the previous day.

NATO in the Space Age—2

DAVID GODFREY, A.F.R.Ae.S., M.I.A.S., *here summarizes "Structure and Material Problems" by* RICHARD V. RHODE *and* JOHN C. HOUBOLT *of NASA, read at the recent AGARD discussion on "The Impact of Space Technology on NATO Research and Development."*

FOR space flight vehicles the trend of structural development over the past two decades has been towards structures of increasing density. Ultimate design stresses have increased and more efficient structural designs have been developed. Latterly, aerodynamic heating has forced changes in structural geometry to reduce thermal stresses, and in more advanced cases, materials of construction have had to be changed and special measures for insulating and cooling have had to be considered.

The trend is expected to continue for many applications, but structures of very low density now also have to be given much attention. The thin-wall construction of liquid-fuelled rockets is an example. The potentialities lying above the present upper limit of the "flight corridor" (see diagram) should be exploited. Finally, for pure space applications with no aerodynamic forces present, low-density pressurized structures have already attracted some attention.

For space vehicle design, one guiding principle is emphasized even more than in aeronautical design: to keep weights low. This fact becomes strikingly clear when cognizance is taken of the fact that under the present state of rocket development, it takes from 200-1,000 lb. of initial weight to put 1 lb. in orbit. The severity of the problem becomes evident when it is realized that much structurally useless material may have to be carried along to provide heat and radiation protection for manned vehicles; furthermore, questions of reliability are of increased importance because of the lower density structures that may be involved.

In the design of a heat-resistant structure, separate consideration will usually have to be given to the surface areas and the leading edges. For the surface areas there are basically four types of construction that lead to a heat-resistant structure. One approach is that of an unprotected structure represented by a sandwich skin of high-temperature material. Structural temperature in this case is governed mainly by the ability of the structure to radiate away much of the incoming heat that is developed by convective boundary-layer heating; the heat capacity of the skin enters only in a secondary manner.

Considerable work has been done on the development of such structures and, in marked contrast to previous design experience, there are now instances of low aspect-ratio wings where the structural engineer can provide a thinner lifting surface than required for aerodynamic reasons, at a saving in weight.

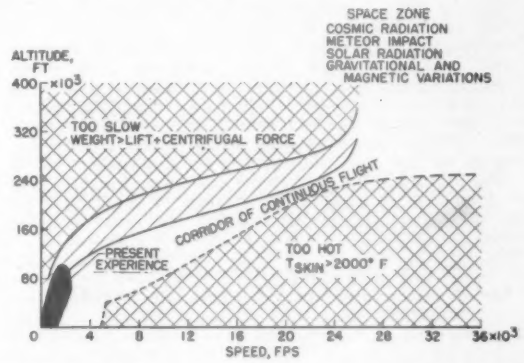
The remaining approaches are basically methods either to block or absorb a portion of the heat input to limit temperature rise. One of these approaches involves the use of an insulated or "heterogeneous" structure in which the inner load-carrying structure is kept cool by an insulation which, in turn, is kept in place by a heat-resistant (radiation) outer shell.

Another scheme, the heat-sink, involves simply the use of a thicker structural skin in order to obtain the desired heat capacity to absorb heat. In this case, the heat capacity of the structure can be raised by the incorporation of materials of high specific heat, such as beryllium, or by the addition of a coolant.

The fourth approach, which is known as ablation, makes use of an external layer of material which absorbs heat as it is consumed; alternate schemes for this case may involve sweat (evaporation) cooling.

The unprotected and insulated approaches are best suited for continuous flight application, and therefore seem most appropriate for manned re-entry considerations. The heat-sink and ablation approaches apply mainly to those cases in which there is a very high influx of short duration and these approaches therefore appear naturally best for ballistic-type re-entry.

There are also four basic schemes for use in leading-edge design. As with the surface structure, either the heat-sink or ablation principles may be used, or as alternatives, the leading edge may be given a protective coating of refractory material, or it may be kept cool through means of mechanical cooling devices. These cooling schemes may involve either the use of a circulating coolant or the use of a gas or fluid which is ejected through slots.

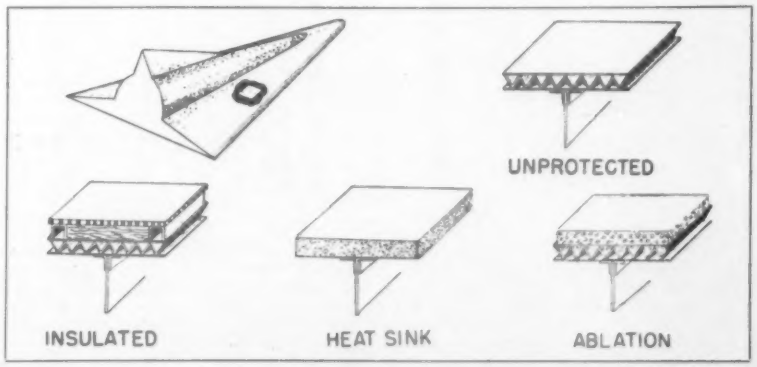


Flight environments shown here indicate present achievement and the future "corridor" available. The upper limit of the "corridor" is set by minimum practical wing loadings: the top line is for dynamic pressures around 10 lb./sq. ft. and the lower for pressures of about 100 lb./sq. ft.

Although certain concepts of construction seem quite clear, additional research is needed to provide guide lines to help the structural designer in selecting the most efficient structural approach for the mission of his particular vehicle.

Structural Analysis Methods

The trend towards low-density type structures for space vehicles seems clear, and to give an idea of the resulting structural problems that require increased attention, the following four are cited: 1. Buckling strength of very thin shells.



The four basic types of wing structure for a space vehicle are shown here. Comparable leading-edge structure can be of heat-sink type, be coated with refractory metals, be mechanically cooled or be cooled by fitting an ablative nose.

2. Prediction of failure modes and general instabilities. 3. The determination of temperature distribution, thermal stresses, and thermal deformation. 4. Efficient design of structural joints.

The buckling strength of thin shells is strongly influenced by initial imperfections. Consequently, the buckling theories for such shells always had to be modified by empirical reduction factors. Recent studies have, however, demonstrated the beneficial effect that may be achieved by use of internal pressurization.

Not all applications will be able to use pressurization. Serious gaps still exist in the unpressurized or partially pressurized regions, and these gaps are widening in scope because the shells now being built or contemplated have proportions outside of the range of previous experience; the radius/thickness ratio, for example, may be two to three times as large as those previously encountered. This change will lead to a substantial loss of strength; experiments are necessary to establish buckling values for this new range of proportions. In addition, the effects of various forms of stiffening on the local buckling of the less dense cylindrical structures have to be considered.

At the present state of knowledge it is seldom possible to calculate with reasonable accuracy the failure modes, strength, or probability of failure of complex structure, and the uncertainty is expected to increase as the structure becomes less dense, or as high heating rates are introduced. Substantial increase in research work on these aspects is therefore needed.

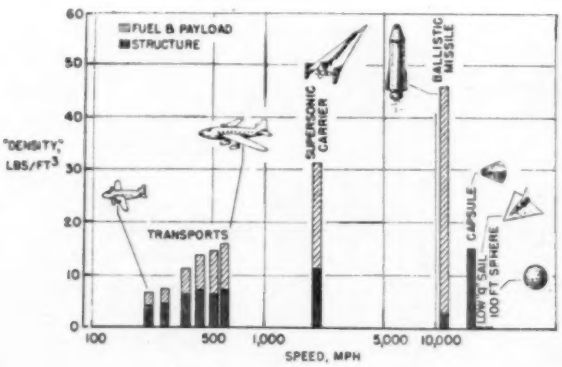
Another severe problem is that of calculating the temperature distribution, thermal stresses, and thermal deformations in the complex structures that will have to be used. While simple in concept, the procedures become very complex when put into practice.

Structural joints are responsible for a substantial decrease in the efficency of structures. Additional information is needed on the resistance to failure of various joint configurations. This problem has become of particular importance because of the necessity of attaching additional material of widely different physical make-up for heat protection, and because realistic consideration must be given the problem of designing joints so as to be load-carrying in one direction while stress-relieving in another.

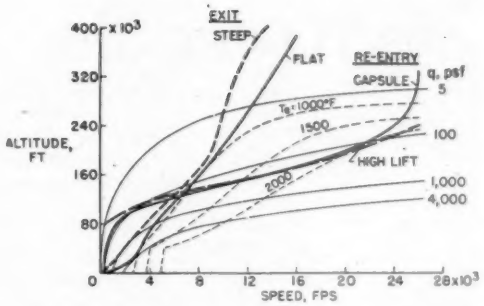
Unusual Construction

Most of the discussion on structures up to this point has been based on vehicles which must pass through the atmosphere; the consideration of vehicles which are intended solely for outer space travel may lead to radically different and novel structural concepts. Since no precedent exists in the field, ideas on the structural configuration are not firmly defined. However, the imagination of those long interested in space has been fertile, and has produced many schemes for spacecraft, most of which have appeared in various periodicals from time to time. Not much can be said concerning purely structural problems, but conjecture can be made.

The vehicles will operate under conditions of essentially zero gravity; this condition, together with the expense of moving weight into space, will result in extremely "flimsy" structures by our earth-bound standards. The efficient design of such lightly-loaded structures and the problem of introducing concentrated loads into the flimsy shells or membrane structures will require much attention.



A comparison of trends in construction for vehicles of vastly different shapes in which the ordinate represents weight divided by displaced volume (i.e. density of construction) and the abscissa is speed. The top of the bars is determined by gross weight and the height of the solid portion is net weight, the shaded area thus representing fuel and payload.



Temperatures and dynamic pressures during exit and re-entry are shown above. Light solid lines are for constant values of "q"; light broken lines are for constant equilibrium temperature "T_e" (the temperature at which the convective heat influx due to boundary-layer heating exactly balances radiative heat flux, measured 1 ft. aft of leading edge); heavy lines are exit and re-entry paths.

Serious proposals have been made to ferry such structures into space in collapsed form and then to inflate or expand them. Methods of reinforcing them must be developed. Already attention is being given the use of inflated tubes as stiffeners or of using a rigidizing foam as a means of reinforcement.

Until now, aluminium and steel have been the primary materials used in aircraft structures and powerplants, and structural joints have been formed largely through the use of rivets. For present and future hypersonic aircraft and spacecraft construction, however, the materials problem is aggravated by high temperature and consideration is being given to nearly all metals and their alloys, to their oxides, and to a host of diverse materials including refractory materials, ceramics, plastics and adhesives.

Two striking trends are prevalent in the development of materials for structural application:—(1) A rapid increase in the types of materials being considered; (2) A marked increase in the number of physical properties of concern.

While most materials exhibit desirable properties of one kind they fail in another. Ceramics, for example, while possessing very good heat resistance and insulation properties, are heavy and brittle and possess very poor tensile and shock-resistant properties. As another example, most of the present ablating materials work well only for very high heating rates, whereby nearly all the heat is consumed immediately at the surface by the ablating process with very little heat being carried through the material by conduction.

For lower heat rates, however, conduction becomes a problem —temperature and thermal stresses occur within the ablation covering with the result that the material cracks or falls away in chunks. There are indications that some of the more recent ablation materials may not suffer these faults, but, in spite of these hopeful signs, much additional development work is needed, especially to determine when and where this relatively new concept of ablation can best be applied.

As space is penetrated, one of the new problems that must be faced is that of radiation effects from nuclear powerplants on structural materials. The problem area is relatively new and not much experience exists. The few tests made in recent years indicate that for many materials no reduction in strength is brought about by radiation; indeed, yield stress and ultimate stress are found to increase substantially in these cases, while ductility seems to decrease.

In other cases, radiation definitely causes a reduction in strength. Also, since a portion of radiation exposure ultimately appears as heat, there may be instances where strong radiation exposure can develop sufficient heat to raise the temperature of the material to a level where conventional metallurgical effects can occur. Another aspect of concern is the fact that prolonged exposure may make the materials dangerously radioactive.

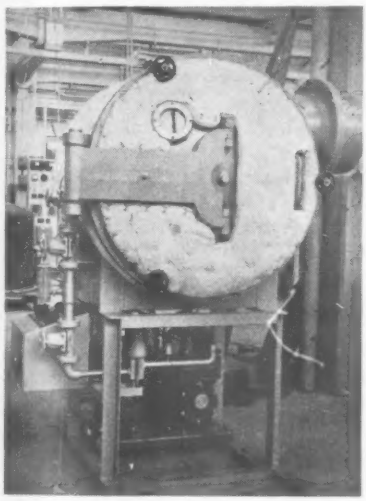
Research is required in the following fields: 1. Extend data on present materials into regions applicable to advanced designs. 2. Develop new improved high-temperature materials through basic research in alloy systems of refractory metals, in the physical chemistry of ceramics, and in adhesives, structural plastics, glazing materials and composite materials. 3. Conduct fundamental research on the physics of solid materials with the aim of finding and understanding the basic laws that govern deformation and fracture. 4. Increase fundamental research in the chemistry of materials, organic chemistry, reactivity, chemical thermodynamics, and mechanisms of oxidation.

News of Industry

Altitude Simulation Plant

AMONG the vacuum chambers recently produced by Edwards High Vacuum, Ltd., of Manor Royal, Crawley, Sussex, for simulating high-altitude conditions is a small, self-contained plant which can reproduce heights of up to 85,000 ft. Used for testing aircraft instruments, this plant consists of a metal work chamber mounted on a pedestal framework under which is a rotary pump. The control equipment is panel mounted on the side of the pedestal.

The chamber itself is constructed from mild steel and is 36 in. in diameter by 30 in. long, with a hinged door at one end complete with a 4-in.-diameter observation window. One side of the chamber is equipped with a blanked-off entry flange and a further observation window incorporating a glass-to-metal seal for thermocouple lead entry. Heating in the chamber is provided by four rod-type elements, designed to give a maximum temperature of 85° C. An electric fan is fitted for heat circulation; the blades inside the chamber and the driving motor are mounted externally at the rear.



An altitude simulation plant produced by Edwards High Vacuum, Ltd., for the testing of aircraft instruments up to heights of 85,000 ft.

The pumping system comprises a Speedivac air-ballasted rotary pump complete with starter, and this outfit is mounted inside the metal framework pedestal under the vacuum chamber. The pumping lines include a magnetically operated air admittance and isolation valve, both wired so that in the event of a power failure the isolation valve will close and seal the system under vacuum, while air is admitted to the rotary pump by the air-admittance valve. Vacuum measurement is provided by a capsule dial gauge, range 0-100 mm.Hg., mounted on the side of the work chamber. Automatic control of the pressure inside the chamber is by a special capsule pressure switch set to a predetermined vacuum and connected to the rotary pump starter.

Similar units can be produced by the company for reproducing conditions at either higher or lower altitudes. Using Speedivac fractionating diffusion pumps, a final vacuum of approximately 10 mm.Hg. can be achieved, which is equal to altitudes of over 500,000 ft.

S.T.C. Radar Demonstration

LAST week the Radio Division of Standard Telephones and Cables, Ltd., gave a live demonstration of its SLA-3 Precision Approach Radar (PAR) to representatives of a number of foreign Governments. For this, the equipment was installed on the roof of the Radio Division building at New Southgate and an aircraft was chartered to make a number of runs over the site.

The SLA-3 is a development of the company's earlier PAR equipment and its radar head, comprising transmitters and receivers, power units and two variable-width waveguide aerials, is accommodated in a prefabricated building. The building itself is mounted on an electrically driven turntable so that a single unit can be sited to cover different runways.

All units with the radar head are duplicated so that a standby channel is immediately available. All test equipment for the various systems is built in, and up to four display consoles may be used with each radar head. On the console a twin display layout is used, incorporating two 17-in. rectangular cathode-ray tubes, and a permanent range of 10 nautical miles is displayed.

This SLA-3 equipment has been installed at Stockholm Airport and at Gwelo in Southern Rhodesia. It is also on order for the new airports at Wellington, New Zealand, and Hong Kong. A mobile version is in quantity production for the R.A.F.

Flight Refuelling in Canada

SINCE its re-establishment as an active concern in 1953, Flight Refuelling (Canada), Ltd., has grown steadily in stature and is now undertaking considerable development work for fuel system equipment associated with the Avro Arrow. The company's success in this direction, in the face of strong competition from the U.S., is a notable achievement.

The Canadian associate of Flight Refuelling was originally established in 1949 but became temporarily inactive after two years when it was found that the American company, Flight Refuelling Inc., could handle the business more conveniently. After occupying premises at Ajax and in Toronto, the company is now at 44 Haas Road, Rexdale.

Nimonics at Hereford

HENRY WIGGIN AND CO., LTD., is concentrating all its production facilities at its Hereford plant. The first stage of this programme was completed recently and all the company's production melting and metal-recovery activities are now concentrated at Hereford. Concentration of activities there will be completed by about 1965.

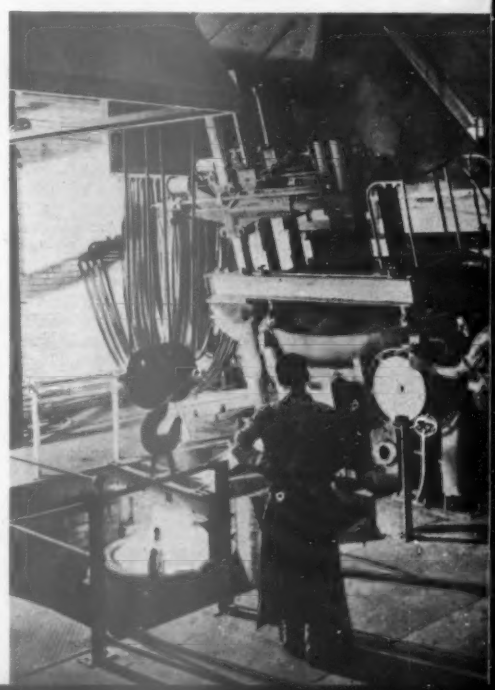
The company's modern Hereford factory was built on behalf of the Ministry of Supply in 1951 for the production of Nimonic alloys. In 1956 the Ministry agreed to its purchase by the company for the production of nickel and its alloys in all their various forms. There is ample room for expansion at this factory, which is laid out on the most up-to-date lines. At present the covered accommodation extends over 6-7 acres, but this will be increased to 26 acres when the activities of the Wiggin plants at Birmingham and Glasgow are moved to Hereford.

At present most of the work at Hereford is devoted to the company's Nimonic and Nimocast alloys for gas-turbine engines. All the main production departments—melting, machining, extrusion, hot and cold sheet rolling—and the inspection and stores are under one roof. Separate buildings house the raw material and scrap stores, pickle shop, boiler house, metal-recovery section, laboratory, canteen, medical department and administrative staff.

Nickel and its alloys are produced in many forms by Wiggins. Although aeronautical outlets, particularly the Nimonic alloys, are perhaps the best-known application, they make up little more than 30% of the company's output by weight, although a greater percentage in value. Other outlets are in the nickel-plating, engineering, marine, chemical, power, atomic and oil industries.

Production and working of the Nimonic alloys involves great attention to detail and thorough inspection at all stages of production. Working temperatures have to be closely controlled; today these are only about 150° C. above the temperatures at which the alloys operate as turbine blades in engines.

The major item of metal-working equipment at the Hereford plant is a 5,000-ton Loewy extrusion press. On this press Nimonic alloys are extruded using the Sejournet technique of lubricating the dies with molten glass. As the heated billets roll down a chute towards the press, glass fibre is wrapped round them; a pad of glass fibre is also inserted in front of the billet before it enters the press. This glass then melts and acts as a lubricant during extrusion.



Pouring the melt from one of the Birlec 3-ton electrode furnaces at the Hereford plant of Henry Wiggin and Co., Ltd.

Private Flying

H.J.C.'s CLUB COMMENTARY

● WITH the intention of reducing flying cost, particularly for C.P.L. pupils, the **Exeter Aero Club** has during the past year offered considerably reduced rates, including a contract rate for solo flying at £1 below the club's normal rates provided a minimum of 50 hr. is purchased and paid for in advance.

Wg. Cdr. R. J. B. Pearse, managing director of Exeter Airport, Ltd., writes that the experiment has been an unqualified success and activities are accordingly expanding. Chipmunks have been obtained, and a Gemini will shortly be available for twin-engine conversions.

Night-flying is now in full swing, and a cross-country route has been approved. Local night-flying is made with Tiger Moths and Chipmunks and the cross-countries in the Chipmunks and Gemini.

It is intended to offer flying to approved students on hire-purchase terms soon. With the possibility of certain industrial banks being interested in financing C.P.L. training, subject to the assurance of employment, these terms should prove of special value.

● IN OCTOBER the **Scottish Aero Club** at Perth achieved a flying total slightly less than in October, 1957. Mr. W. Rennie and two A.T.C. cadets gained their P.P.L.s and Mr. T. W. Gow made his first solo. Film evenings and lectures have begun and have been well attended.

● WE HEAR that the **Herts and Essex Aero Club** is to change hands, and that Mr. Charles Morley, who flies from Southend, will be the new owner. The former C.F.I. at Southend, Mr. "Gerry" Quinn, is reported to be the new manager of the club located at Stapleford Tawney Aerodrome.

The present C.F.I. of the club is Mr. N. Browning; part-time instructors are Messrs. N. Jones, F. Lister and L. Richards. The secretary is Mr. R. Randall.

The aircraft fleet consists of a Hornet Moth, G-ADOT; three Autocrats, G-AGYD, AHHN and AJEI; two Tigers, G-AIDS and ANKU; and a Gemini, G-AJEX.

● AT THE **Southend-on-Sea Municipal Air Centre and Flying School,** Mr. John K. Keates replaced Mr. Quinn as C.F.I. some months ago. Other instructors there are Messrs. B. Warman and L. Swanepoel, and about a dozen part-time instructors are available from time to time.

Four Autocrats, G-AGTX, AIZY, AJEO and AJUE; two Chipmunks, G-AOTV and AOFE; and an Autocar, G-AMFP, are now operated by the school.

GERMAN JODEL.—Aero-Flugzeug Hubert Zuerl, of Heimstetten, near Munich, has developed its 65-h.p. Continental-engined Aero-Jodel D.11A Club, which has received its German Federal Aviation Board type certificate for home-building and commercial construction, into a 90-h.p. version. The loaded weight is increased to 1,433 lb.

● ONCE AGAIN it looks as though Coventry's Baginton aerodrome will be the site chosen for the National Air Races next year. It is understood that the aerodrome committee is to ask the City Council to apply to the Royal Aero Club for permission, suggesting July 9-11 as the dates. The last Coventry Air Day resulted in a deficit of £304 15s. 3d., of which the Corporation's share is £72 11s. 2d.

● AMERICAN airmen stationed near Prestwick formed a flying club some months ago and are now looking for a suitable aerodrome, reasonably close to Prestwick, from which they can fly. An aeroplane has already been obtained, and is being flown from Prestwick, but for instructional flying another site must be found. Concerned with the running of the club are Maj. G. Woods and Sgt. R. Bann.

Gliding Notes

by Dr. A. E. Slater

AMONG the meteorological phenomena which provide lift for soaring, there is one called a "shearline," which appears to be a peculiar form of localized front found near Los Angeles. Of course, there are shearlines of sorts all over the place, but only this one has been regularly exploited by sailplanes, especially at the 1954 United States contest held at Elsinore, south-east of Los Angeles. In the September-October, 1958, issue of *Soaring*, Jack Lambie outlines plans to investigate this shearline with an OSTIV grant, though it is not clear if the money has yet been granted.

The shearline is easily visible as a mass of hazy air, carrying industrial murk from Los Angeles, advancing inland on a 40-mile front, along which it is often possible to soar to heights which vary from 600 to 10,000 ft., probably depending on the temperature difference between the clear and murky air. With its passage the wind veers towards north. When Lambie contacted the local scientists working on "smog research," they were surprised to hear that the advancing edge produced frontal effects and that soaring flights had been made along it at various times during the past four years.

* * *

The coolness of the murky air was originally attributed to the smoke particles cutting off sunlight from the ground below, and Jack Lambie still subscribes to this theory. Two years ago (*Soaring*, May-June, 1956) he pointed out that soaring along the line was more difficult the hazier the air was in front of it; i.e., the less the difference in haziness between the two air masses.

However, John H. Aldrich, chief aviation forecaster at Los Angeles, who did the met. briefings at the 1954 contest, wrote afterwards (*Soaring*, September-October, 1954) attributing the phenomenon to a plain sea-breeze effect, the murk happening to be picked up only because the incoming sea air passes over Los Angeles first. He says the boundary may shift back and forth across Elsinore "gliderport" six to 10 times a day, whereas Lambie describes it as continually advancing, typically at about 5 m.p.h.

The advancing front is usually not straight, but wavy, and the best lift is likely to be where parts of it project in front of the rest. One is reminded of pilots soaring along Dunstable Downs on an unstable day, who find extra lift over a bastion sticking out from the main ridge. On stable days one would expect the bastion to split the air stream, but in unstable weather the approaching hot surface air reaches it first, is loosed off as a thermal, and gathers in more hot air from either side.

Our own Reginald Rainey believes that the strong lift along a cold front, which is stronger than can be accounted for by mechanical lifting of one air mass by the other, is due to the hot surface air being disturbed and loosed off simultaneously all along the line, producing a continuous belt of thermal lift. Similarly, Lambie describes a flight along the shearline during which dust devils were at their most active along and near the line.

Yet, according to Lambie, there is "a soarable shearline even on dull, overcast days. Apparently, the mere presence of the two masses is enough to cause lift."

IT was announced at the time of the late Frank Foster's funeral that flowers should not be sent but that, instead, contributions could be forwarded to the London Gliding Club. The club has now decided to establish a Frank Foster Memorial Fund; details of the memorial are not yet decided, but meanwhile donations should be sent to the London Gliding Club, Dunstable Downs.

* * *

AT the Long Mynd, the Midland Gliding Club announces, there will be a "Wave Safari" from December 26 to January 4. A party from Lasham is expected with five sailplanes, and another from the Yorkshire Club. It is hoped that the wave will lay itself on, as it often does at that time of year.

* * *

PRINCIPAL guests at the Kronfeld Club's first annual dinner and dance, held at the Eccleston Hotel, London, on November 7, were Col. C. F. H. Gough, R.Ae.C. chairman, and the Rt. Hon. Lord Sempill, who was introduced, by a slip of the tongue, as the Master of Sempill. The slip was pardonable, as that is how he was known during the early years of the British Gliding Association, whose president he was for a time, when he was a regular attendant at gliding meetings, usually turning up in his own aeroplane. He was surprised to recognize as many as four old acquaintances of those days who were still active in gliding after a quarter of a century.

* * *

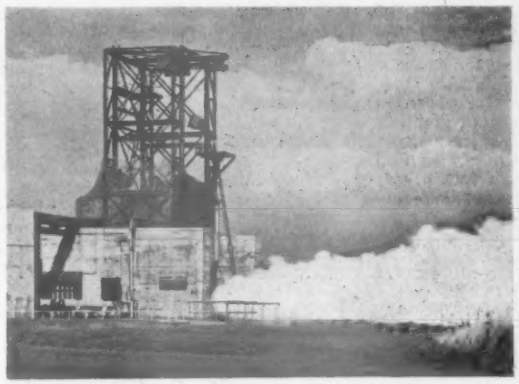
Bristol Gliding Club has 220 members, of which 144 are flying members, and this year's holiday courses have been attended by 175 pupils. The club has 12 sailplanes and its fleet will soon be joined by a Tiger Moth for aero-towing.

(*Continued from page* 741)

NEXT WEEK

THE AEROPLANE of November 28 will be largely devoted to a review of British and Commonwealth Naval Aviation. Well-illustrated articles on the history of the Fleet Air Arm, its present and future organization and tasks, flying training, and an around-the-stations review will be included besides an account of the activities on H.M.S. "Victorious," with special reference to Supermarine Scimitars and D.H. Sea Venoms equipped with Firestreak missiles.

The issue will cost the usual 1s. 6d. and can be obtained from all booksellers and newsagents or direct from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1.



RESEARCH ROCKET.—On test at the Ansty Engineering Centre of Armstrong Siddeley Motors, Ltd., is a Gamma Mk. 201 rocket engine as used on the Black Knight research missile. The four-barrel HTP- and kerosene-burning Gamma has a thrust of 16,400 lb. at sea level rising to 19,000 lb. outside the Earth's atmosphere. In the test stand the rocket blasts downward on to a tank of water to turn the efflux through a right-angle and produce the steam seen here.

MASTER FLIGHT SYSTEM.—The General Electric Co. of America has developed a master flight reference system which integrates outputs for auto-pilot, Doppler navigation, low-level bombing, dead-reckoning equipment and an all-attitude compass indicator. The first application of the system is in the U.S. Navy's A3J Vigilante.

NEW PIPER.—Designed specifically for flying club and private owner use the four-seat Piper Caribbean has been developed from the PA-22. It is powered by a 150-h.p. Lycoming engine.

TRANSATLANTIC RECORDS.—The records set up by a Boeing KC-135 Stratotanker over the Atlantic on June 27 last have now been officially confirmed. The aircraft (four Pratt & Whitney J57-P-43W turbojets), piloted by Maj. B. B. Davenport, U.S.A.F., covered the New York-London distance in 5 hr. 29 min. 14.64 sec. (1,014.248 k.p.h.) and the return flight in 5 hr. 53 min. 12.77 sec. (945.423 k.p.h.).

Commercial Aviation Affairs

MORE VISCOUNTS.—T.A.A. announced last week its order for two Viscount 816s for delivery in April and May, 1959. Ansett A.N.A. already has four Viscount 832s on order for delivery between January and April. B.E.A. have ordered an additional Viscount 806 (G-APOX) as a replacement aircraft. The Viscount 763 ordered by Howard Hughes has now been delivered to TACA in El Salvador. For their recent demonstrations in Austria and Poland, Vickers have used two of Continental's Viscount 812s registered respectively G-APPC and G-APPU.

. . . AND TWO LESS.—On November 10 a T.C.A. Viscount 724 was severely damaged and probably written off when it was hit by a Seaboard and Western Constellation on the ground at Idlewild. Both aircraft caught fire but none of the crews on board was injured. Another recent Viscount loss involved one of the three V.755s operated by Cubana. This crashed into the sea on November 1 off the Cuban coast, reportedly as a result of rebel activity. Seventeen of the 20 occupants were killed.

FOLLOWING SUIT.—Eagle Airways have announced their intention to make new low fares available on normal international scheduled services for inclusive tour holiday passengers on certain routes next year, particularly to Northern Italy and Austria. An associated company, Eagle Aviation, already provides aircraft to travel agents for cheap inclusive tours by air and will continue its policy in 1959.

AIRPORT ACTIVITY. — During August, 1958, movements at U.K. aerodromes were 3% above those for August, 1957; passengers increased by 3.5% and freight by 28%. Traffic at London Airport decreased by about 5% in favour of Gatwick but there was an increase of some 5% in the London area as a whole. Only London and Southend had more movements than Croydon during the month although the large majority of Croydon movements were by club and private aircraft.

FRIENDSHIP SERVICES—I. — The first two Fokker F-27s for Aer Lingus were to be delivered at Dublin on November 19. This type will go into service on the Dublin-Paris route in mid-December, and shortly thereafter will replace DC-3s on the routes from Dublin to Manchester, Liverpool, Cardiff, Bristol, Glasgow, Edinburgh and Birmingham.

FRIENDSHIP SERVICES—II.—The first scheduled service by a Fairchild F-27 was operated by West Coast Airlines from Seattle on September 28. Avensa started service from Caracas on October 3 and Quebecair flew their first service from Montreal on October 27.

EL AL TO JOHANNESBURG.—Israel Air Lines reintroduced its weekly tourist service to Johannesburg from Tel Aviv on November 17, using DC-6Bs.

WEST INDIAN NEGATIVE.—An application by Eagle Airways (Bermuda) to operate the service between Bermuda and Trinidad via Antigua and Barbados has been turned down by the West Indian Government.

WELLINGTON AIRPORTS.—Approval in principle has been obtained for the construction of a new airport at Paraparaumu, north of Wellington, to serve as an alternative to the new airport now being built at Rongotai.

DAILY FLIGHTS.—B.O.A.C. opened its daily Comet service from New York to London 24 hours early on November 13 when the Stratocruiser which should have operated the service was delayed in London by fog. The first service to New York operated as planned on November 14. Stratocruisers have now been withdrawn from the North Atlantic route and are being phased out of service. A daily service by Britannia 312 between London and New York also began on November 14.

TRANSATLANTIC JETS. — Pan American's first New York-London Boeing 707 service scheduled to arrive on November 16 was delayed by fog. The aircraft had to stop overnight at Shannon and did not arrive at London Airport until 12.45 hrs. the following day, some 13½ hr. late.

SERVICES FROM MANSTON?—Silver City Airways have applied to the A.T.A.C. for permission to use Manston Airfield in Kent as an alternative to Ferryfield for their vehicle ferry, normal scheduled services and inclusive tour services next year.

PRESTWICK PLANS.—Mr. Watkinson has announced that the Prestwick development plan, costing over £2 million, involves the extension of the main runway, diversion of the A77 road round the end of it, and construction of a new terminal area at the Redbrae site.

VISCOUNT IN WARSAW.—A Vickers Viscount 812 was demonstrated to the Polish airline LOT in Warsaw on November 13, and was the first sales visit by a British aircraft behind the Iron Curtain. About 150 people were carried on three flights and the aircraft made an excellent impression.

STOCKHOLM ARLANDA.—Stockholm's new international airport is to be known as Arlanda, after an old community in the vicinity. The project has previously been known as Halmsjön, where work on the construction of a new airport began some 10 years ago but was later discontinued through technical difficulties. Halmsjön was re-selected a year ago as the site for the new airport. It is expected to be ready for use by the end of 1959.

HURRAH FOR VISCOUNTS.—According to Mr. Robert F. Six, president of Continental Airlines, their Viscount II is the "quietest, smoothest and fastest airliner flying in the United States today. Performance, passenger appeal and economics . . . have exceeded expectations of the company." Direct cost per aircraft mile during August proved to be 15.69 cents below forecast and available seat mile costs were .30 cents below forecast.

AUSTRALIAN STOP. — Southern Airlines, Ltd., of Victoria, Australia, has ceased operation of its local services. Competition from Ansett-A.N.A. and refusal of the Federal Government to grant a subsidy are given as the reasons.

LOAN FOR ALITALIA.—The U.S. Export Import Bank has authorized a loan of $13.7 million to Alitalia for the purchase of four DC-8s. This price is exclusive of the Rolls-Royce Conway engines to be used in these aircraft.

SENATOR BY LUFTHANSA.—Described as "the most luxurious service" on the North Atlantic, the Lufthansa Senator service is to be operated four times a week with L.1049G Super Constellations, arranged to carry 32 passengers.

PLANS FOR C.A.A.—The Minister of Transport for Rhodesia and Nyasaland, Mr. W. H. Eastwood, has said that Central African Airways will be established as a Federal Statutory Corporation. Since the Federal Government assumed responsibility it has invested £650,000 and guaranteed a re-equipment loan of £1.75 million. In September, C.A.A. traffic decreased by 13% as compared with last year.

News About People

ELECTRONICS POST.—Mr. J. N. Toothill, general manager of the Edinburgh factory of Ferranti, Ltd., has been made a director of the company. He is a member of the Scottish Civil Aviation Advisory Council and of the equipment group committee of the S.B.A.C., and a governor of the College of Aeronautics, Cranfield.

GLIDING CHAMPIONSHIPS.—The 1959 British National Gliding Championships will be held at Lasham Gliding Centre, near Alton, Hants, from May 10 to 18. The preliminary seeded list of 15 pilots who will be expected to fly in League I is: P. Bisgood, G. Burton, Lt.-Col. A. Deane-Drummond, Flt. Lt. K. C. Fitzroy, Lieut. Cdr. G. A. J. Goodhart, Cdr. H. C. N. Goodhart, Sgt. A. Gough, D. H. G. Ince, Dr. B. James, M. Kay, D. A. Smith, G. H. Stephenson, L. Welch, J. S. Williamson, and P. A. Wills. But for the death of Frank Foster he would undoubtedly have been included in the list.

D.H. VISITORS.—Spanish aviation experts, including Snr. Don Juan Antonio Suances, president of the Spanish National Industrial Institute, Gen. Don Manuel Martinez Merino, Director-General of Civil Aviation, and the president of Iberia, Snr. Don Tomas Delgado visited the de Havilland Aircraft Co., Hatfield, on November 11, and made a 2-hr. flight in a Comet. Later in the week the party visited de Havilland Propellers, Ltd., and saw Firestreak AAMs, the de Havilland Engine Co., and the Rolls-Royce Derby works.

CHAPLAIN-IN-CHIEF.—The Rev. F. W. Cocks, M.A., has been appointed Chaplain-in-Chief to the R.A.F. as from April, 1959, in succession to Archdeacon A. S. Giles, C.B., C.B.E., M.A., who is retiring from the Service.

INDEPENDENT APPOINTMENTS.—Mr. A. E. Cooper, M.B.E., M.P., has been appointed chairman of Independent Air Travel, Ltd., Captain T. E. Langton has resigned from the board and Captain F. Lloyd has been appointed a director. Mr. M. K. Kozubski remains managing director and Mr. D. M. Ebbutt is the technical director.

AIRPORT MANAGER.—Mr. G. P. Sellers has been appointed manager of Yeadon Airport, which is to be derequisitioned at the end of the year and will be taken over by the Leeds-Bradford Joint Aerodrome Committee. Mr. Sellers has been at Yeadon for 15 months as senior controller, and was previously a controller with International Aeradio.

U.K. REP.—Air Cdre. K. J. McIntyre, C.B., C.B.E., has been appointed representative in the U.K. for the Royal Netherlands Aircraft Factories, Fokker, at 175 Piccadilly, London, W.1.

RECOGNITION.—A bronze bust of Lord Hives has been placed in the entrance hall of the Rolls-Royce headquarters in Derby, beside those of Sir Henry Royce and the Hon. C. S. Rolls. The bust is the work of Sir Charles Wheeler, president of the Royal Academy.

ICAO PERSONNEL.—Elected vice-presidents of ICAO for 1959 are Mr. W. G. Algar (Ireland), Col. A. E. Chagas (Brazil) and Mr. H. Söderberg (Sweden). Mr. A. X. Pirson of Belgium has been re-elected chairman of the Air Transport Committee.

AWARD FOR TUPOLEV.—In recognition of his services to Russian aviation, Andre Tupolev, who, it is stated, has now designed more than 100 aircraft, has been awarded the Order of Lenin.

Military Aviation Affairs

AUSTRALIAN TRANSPORTS.—The first five of the 12 Lockheed Hercules transports for the R.A.A.F. should arrive at Richmond, Australia, on about December 12. The Australian Ambassador to the U.S., Mr. Howard Beale, Q.C., has indicated that his country may buy additional Hercules.

PATHFINDER BALL.—This year's Pathfinder Ball will be held at the Dorchester, Park Lane, London, W.1, on December 6. Tickets, price 42s., and booking arrangement details can be obtained from The Pathfinder Association and Club, 115-118 Mount Street, Berkeley Square, London, S.W.1.

R.A.F. PRESENTATION.—The Jordanian Air Force held a dining-out night for the R.A.F. in Amman just before British forces left Jordan. King Hussein attended, and during the evening Gp. Capt G. B. Warner (right), Senior R.A.F. Officer in Amman, presented His Majesty with a replica of the badge of No. 208 Squadron "resident" fighter squadron for the emergency period.

R.A.F. SHEPHERDS GROVE.—The U.S.A.F.E. is to return R.A.F. Shepherds Grove, Suffolk, to the Air Ministry next year. Occupied by the Third Air Force since 1951, the station is at present the base of the 78th Fighter Squadron, which is to be transferred to Woodbridge in the spring. The squadron is to be re-equipped with F-101 Voodoos before it is moved.

BRITISH THORS—U.S. reports state that 60 Thor IRBMs are to be delivered to Britain by the end of 1958. The missiles and their support equipment are being flown to Britain from Long Beach, California, in Douglas Globemasters. Thirty delivery flights a month are scheduled.

NO. 2 SQN. REUNION.—It is proposed to hold a reunion dinner for the aircrew of No. 2 Sqn. in March next. Any former squadron members who are interested in attending should contact Sqn. Ldr. C. S. MacDonald, R.A.F. Selection Board, R.A.F. Cranwell, Sleaford, Lincs.

Correspondence

Junkers in New Guinea

MAY I refer back to your issue of May 30 in which Mr. Shackleton refers to the Ju 52 in New Guinea?

I can vouch for Bill Shackleton's statement because I was flying G-31s for Guinea Airways, Ltd., when he visited New Guinea after selling us four Ford 4 Trimotors ex-B.A.N.C.O. of Heston, England.

You state that the Ju 52 was a single-engine monoplane; far from it, the Ju 52 was a three-engined aeroplane and was used extensively by the German Air Force in the same way as the DC-3 was, and is, used by the R.A.F., etc. Ju 52s have been seen in New Guinea during the past two years when Gibbs Sepik Airways imported three.

The single-engined Junkers you refer to are the F-13 of which Mr. Beardmore had one floating around at Hanworth during the early '30s. Guinea Airways also had one plus three W-34s. They were also used in Canada on floats and skis. The W-34 on floats behaved beautifully and was a floatman's dream when powered with a Pratt & Whitney Hornet.

Hebel, Queensland, Australia. G. W. CANNON.

[We agree that the nomenclature is misleading but if Mr. Cannon will refer to the appropriate volume of "All the World's Aircraft" (1930) he will find that there was a single-engined version of the Ju 52. It had a single 800-h.p. Junkers L.88 water-cooled engine. The three-engined version became the Ju 52/3m.—ED.]

The Flying Can-openers

HAVING seen in THE AEROPLANE for October 10 a photograph of a Canberra B.2 with the "Flying Can-opener" insignia on the tip-tank, I recognized it as being one of No. 6 Squadron's aircraft, so naturally read the letter from Mr. John D. R. Rawlings.

No. 6 Squadron did, in fact, have the "Flying Can-opener" insignia on the silver tip-tanks of its Venom FB.4s with which it was previously equipped up to the beginning of last year. Naturally the Canberra crews wished to continue with the tradition.

I think the Venom was the first aircraft since the Second World War to have the "Flying Can-opener" insignia.

Bridgnorth. "SIXMAN."

Comet Pilots

A DINNER was held at the Royal Aero Club on November 4, as your readers know, to honour the Comet team.

Many laudatory remarks were made and there was, quite rightly, much stress laid on the highly successful team work which went to produce the Comet 4.

In his speech John Cunningham referred to this, and also to a dinner which took place 24 years ago to celebrate the success of the original D.H.88 Comet. In this connection he included some complimentary remarks about myself, and I therefore think it appropriate for me to point out that no one paid a tribute to him for the immense amount of work and skill he has put in over a long period in connection with the test flying of all the Comets.

In spite of all the modern aids, most of which are navigational, it is still the chap in the pilot's seat who has to be relied on to take the aircraft up and put it down again safely.

I have, of course, no knowledge of all the snags that must have arisen and been overcome, in this tremendous effort, needing hundreds of hours of concentrated flying, and am sorry that someone with more information on the inside story did not sing a word of praise for this outstanding effort.

May I therefore on my own account, and perhaps of many others, sound a little trumpet on behalf of one of our greatest and most courageous pilots?

Piccadilly, London, W.1. HUBERT BROAD.

The Winged Rocket

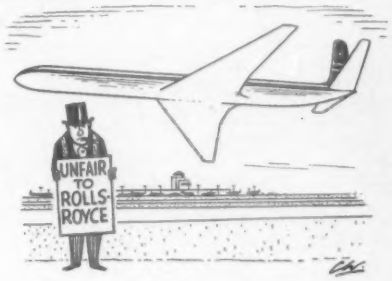
UNITS of crockery and rocketry seem to have a little in common—neither are worth picking up once they have been inadvertently, or "purposefully launched" and landed—and even those larger lunar rocket probes become, so we are told, dust and cinders before finally settling into the sea, or spread far and wide over the surface of our long-suffering Earth. Eventually, so it is predicted, ceramics, refrigeration, gravity reversers, or braking devices, will provide the means for a "one-piece" return through our higher atmospheric layers, on the inwards journey from outer space.

Years ago lots of talk occurred, but little action followed, about the development of telescopic wings. A glide path return to Earth, by a rocket with such wings in the right material, suitably cooled, appears to be a more attractive method of covering the last stages of the return journey than a "hot plummet" into the vast briny—or perhaps somebody's back yard?

Gloucester. LESLIE MORGAN.

Wroundabout

Derby Doomed. Gordon Swanborough, of this journal's air transport section, was interested to hear at the G.A.T.C.O. Convention a B.O.A.C. lecturer say that in the unlikely event of a Comet losing an engine, its range would be reduced by about 5%. "Swanny" and I, with our slide-rule, have worked out that on this basis, the loss of *four* engines would reduce range by 20%, giving an engineless range of 80% of the powered one, or about 3,000 miles in still air, with no reserves. I don't know whether to be sorry for the engine industry or delighted at the rosy future that this revelation must mean for the airlines.



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Strictly for the Birds. At the Boeing 707 school, the instructor asked the airline trainees if they knew what would happen if a foreign body was sucked into the engine. "Supposing, for instance, a duck flies into the intake?" he said.

"The engine explodes?" asked a member of the group.

"No. All it does is feather the engine."

*

Problem Solved. When an irresistible force meets an immovable body, it goes right on through without leaving a hole.—*From Convair's "Cornvairiety."*

*

"Nice autobiography of yours, old man—who wrote it for you?"

"Glad you liked it, old boy—who read it to you?"

*

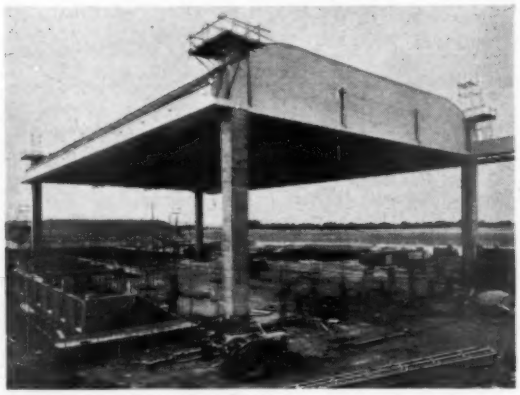
Fly Paper Comes Unstuck. Did you hear about the airline which was doing "paper" flights, based on actual conditions, as part of its preparation for operating one of the new mighty jetliners on a transocean route? The first three flights finished up in the ocean. Fortunately for all the paper people on board, it was a paper ocean.

*

From "Lloyd's List": Piper J-3 HB-OEY made a heavy landing and was damaged at Prangins, Switzerland.

by Wren

NOTES AND EVENTS



NEW ACCOMMODATION.—Each bay of a three-bay hangar being built at the R.A.F. Transport Command Station, Abingdon, by John Laing and Son, Ltd., will be able to house an aircraft of Beverley or Britannia size. This picture was taken after the raising of the roof of the first bay.

POLISHING PROCESS.—A process for deflashing, surface smoothing, and producing a lustre on plastics components has been developed by Roto Finish, Ltd., of Hemel Hempstead, eliminating the need for hand polishing. This company also markets a machine suitable for the process.

HEADSETS AND MASKS.—Airmed, Ltd., of Harlow, Essex, has produced new airborne headset equipment known as the Airlite and a range of quickly attachable oxygen masks. The headsets have been specifically designed for use in turboprop and turbojet transports and have been chosen by B.O.A.C. for the Comet 4s. Both the headset and the oxygen mask assemblies have received A.R.B. and M.T.C.A. electrical approval.

METAL EXPANSION.—The whole of the ordinary and preference share capital of the Glasgow Expanded Metal Co., Ltd., has been acquired by the Expanded Metal Co., Ltd., of London and West Hartlepool. This follows the taking over of the Cressall Manufacturing Co., Ltd., of Birmingham, and the establishment of a Canadian Expanded Metal Co.

AT THE N.P.L.—From November 24 to 27 a symposium on "The Mechanization of Thought Processes" will be held at the National Physical Laboratory, Teddington. Papers will be read on: general principles; automatic programming; language translation; speech recognition; learning in machines; implications for biology and implications for industry. More than 200 delegates will attend the symposium, which will be opened at 12.00 hrs. on November 24 by the director of the N.P.L., Dr. G. B. B. M. Sutherland, F.R.S.

FOR THE U.S.A.F. — Following extended tests, the Canadian Applied Research, Ltd.'s airborne profile recorder, a radar aid to surveying and mapping techniques, is to be fitted into 15 Lockheed RC-130 Hercules, which are to undertake an extensive mapping project. Capable of measuring topography from 1,000 to 35,000 ft. the equipment is an improved precision radar designed for air-survey work.

RADAR TRAINER.—Marconi's Wireless Telegraph Co. Ltd., has supplied a complete radar training installation for the R.A.F. The equipment provides two synthetic radar echoes on the P.P.I. tubes and has four separate flight simulator positions and two display consoles.

Company Notices

OVERSEA COMPANIES

Aircraft Associates, Ltd. (F.4,740).—Particulars filed Oct. 29, 1958, pursuant to Section 407 of the Companies Act, 1948. Cap.: 1,000 in £1 shs. Reg. in Ireland on Oct. 30, 1953, as Irish Sales and Commodities Company, Ltd., and renamed as above on Dec. 31, 1956. British address: 26 Old Bank Buildings, Chester. Thomas Wayman-Hales, of The Priory, Abbey Rd., West Kirby, Ches., is authorized to accept service of process and notices. Directors: Denis Greene, Ceanchor Cottage, Baily, Co. Dublin; Thomas Wayman-Hales, The Priory, Abbey Rd., West Kirby, Ches.; Patrick N. Leonard, "Caragh," Sandyford Rd., Dundrum, Co. Dublin.

W.A.A.C. (Nigeria), Ltd. (F.4,743).—Particulars filed Oct. 29, 1958, pursuant to Section 407 of the Companies Act, 1948. Cap.: £6,000,000 in £100 shs. Reg. in Federation of Nigeria on Aug. 23, 1958, to take over all or any part of the business carried on by West African Airways Corporation. British address: 32 New Bond St., London, W.1. Sir William F. Broadbent, of 32 St. James's Place, London, S.W.1, is authorized to accept service of process and notices. Directors: Rowland W. C. Baker-Beall, Beer Haven, Beer, Seaton, Devon; Wilfred C. G. Cribbett, 108 Collingwood House, Dolphin Square, London, S.W.1; Shafi L. Edu, Abah O. Ene, Leslie E. T. Evans, John H. Joyce and Sule Katagum.

Birth Notices

Davies.—On November 9, at Chiswick Maternity Hospital, to Olive (*née* Birks), wife of Wg. Cdr. D. E. Davies (Retd.)—a daughter.

Nugent.—On November 8, at Harrogate General Hospital, to Diana Clare, wife of Flt. Lt. N. A. D. Nugent, R.A.F.—a son.

Powell.—On November 8, at the Buddleia Nursing Home, Witney, to Jacqueline (*née* Clay), wife of Wg. Cdr. C. E. Lionel Powell—a daughter.

Shaw.—On November 7, at Epsom District Hospital, to Doreen (*née* Grant), wife of Flt. Lt. E. J. Shaw, A.F.C., R.A.F.—a son.

DEATH

Varley.—On November 3, after a long illness, Fly. Off. Rowland Appleton Varley, North Staffs, R.F.C., R.A.F. (Retd.).

Aviation Calendar

November 24.—Royal Society of Arts Cantor Lecture, "The Birth of the Aeroplane," by Mr. C. H. Gibbs-Smith, M.A., F.M.A., at John Adam Street, **London**, W.C.2, at 18.00 hrs.

November 24.—R.Ae.S. Guided Flight Section lecture, "Inertia Guidance," by J. E. Pateman, at the Institution of Civil Engineers, Great George Street, **London**, S.W.1, at 18.00 hrs.

November 25.—G.A.P.A.N. lecture, "The Jetstream," by E. Chambers, in the Convocation Hall, Church House, Westminster, **London**, S.W.1., at 18.30 hrs.

November 25.—R.Ae.S. Belfast Branch, film show, at the Queen's University, **Belfast**, at 19.30 hrs.

November 26.—R.Ae.S. Christchurch Branch lecture, "Parachutes," by F. B. Jackson, at the King's Arms Hotel, **Christchurch**, at 19.30 hrs.

November 26.—R.Ae.S. Bristol Branch, Junior Members Paper Competition, at Filton House, **Bristol**, at 18.00 hrs.

November 26.—Kronfeld Club, talk by T. W. Brooke-Smith of Shorts Gliding Club, at 74 Eccleston Square, **London**, S.W.1.

November 27.—R.Ae.S. Southend Branch lecture, "Agricultural Aircraft," at the Labour Hall, Boston Avenue, **Southend**, at 19.30 hrs.

November 29.—Elstree Flying Club annual dinner, at The Green Man, Kingsbury, **London**, N.W.9, at 19.30 for 20.00 hrs.

December 1.—Royal Society of Arts Cantor Lecture, "The Development of the Aeroplane," by P. Brooks, B.Sc.(Eng.), A.C.G.I., A.F.R.Ae.S., at John Adam Street, **London**, W.2, at 18.00 hrs.

December 1.—R.Ae.S. Derby Branch lecture, "Thrust Reversal for Jet Aircraft," by R. H. Colley, at the Rolls-Royce Welfare Hall, Nightingale Road, **Derby**, at 18.15 hrs.

December 1.—R.Ae.S. Halton Branch lecture, "The Solar System," by Sqn. Ldr. E. A. Newman, at the Branch H.Q., R.A.F. **Halton**, at 18.45 hrs.

December 1.—R.Ae.S. Henlow Branch lecture, "Long Range Forecasting," by Sir G. Sutton, in Building 62, R.A.F. Technical College, **Henlow**, at 19.30 hrs.

December 2.—R.Ae.S. Luton Branch lecture, "Satellites," by E. M. Dowlen (English Electric Co., Ltd.), in the Napier senior staff canteen, **Luton Airport**, at 18.15 hrs.

December 2.—Institute of Metals, Oxford Section lecture, "Inter-Planetary Travel," by L. R. Shepherd, Ph.D., at the Cadena Café, Cornmarket Street, **Oxford**, at 19.00 hrs.

December 3.—Kronfeld Club talk by Alan Yates, at 74 Eccleston Square, **London**, S.W.1.

December 4.—R.Ae.S. Main Lecture at Birmingham Branch, "Freighters — A General Survey," by E. D. Keen, F.R.Ae.S., at the College of Technology, **Birmingham**, at 19.00 hrs.

December 4.—R.Ae.S. Christchurch Branch, joint lecture with the Institution of Mechanical Engineers, "Aero Engines Past, Present and Future," by A. D. Baxter, at the King's Arms Hotel, **Christchurch**, at 19.30 hrs.

December 4.—R.Ae.S. London Airport Branch lecture, "Airline Operational Flying," by Capt. W. Baillie, M.V.O., O.B.E., A.F.R.Ae.S. (general flight manager, B.E.A.), in B.E.A.'s Viking Centre Cinema, Harton Cross, **London Airport**, at 18.00 hrs.

December 4.—R.Ae.S. Bristol Branch lecture, "Britannia: An Operator's Report," by J. E. D. Williams, at Filton House, **Bristol**, at 18.00 hrs.

December 5.—Helic. Assn. of G.B., discussion evening, in the R.Ae.S. Library, 4 Hamilton Place, **London**, W.1, at 18.00 hrs.

STARTING COMETS.—Auto Diesels, Ltd., of Uxbridge, has received a £72,000 contract for aircraft-starting equipment for the new Comet 4 fleet to go into service with Aerolineas Argentinas.

New Patents

APPLICATIONS ACCEPTED

806,614.—Cooke, W. D.—"Aircraft provided with lifting rotors."—Jan. 2, 1957. (March 20, 1956.)

806,686.—English Electric Co., Ltd.—"Aircraft undercarriages."—March 21, 1957. (March 29, 1956.)

806,849.—Salomon, F. M. M. B.—"Apparatus for combating oscillatory movements of structures, for example, ships."—Feb. 1, 1957. (Feb. 1, 1956.)

Applications open to public inspection on Dec. 31, 1958; opposition period expires on March 31, 1959.